April 1943

TECHNOLOGY REVIEW

Title Reg. in U. S. Pat. Office

Get the "GRINDLINS" out of your Tool Room

Grindlins in the tool room are cousins of the Gremlins that cut capers with airplane pilots.

"Make the old wheel hog off the metal," suggests Mister Grindlin. "Pipe down," says experience, "the one way to assure uniform tooth height when grinding milling cutters is by taking light finishing cuts of not more than one-half a thousandth per pass."

Don't let Grindlins heckle your workers. There is a Norton Handbook on Tool Room Grinding, 176 pages of helpful information and illustrations, that will be definitely useful to the tool room worker who is new to his job.

NORTON COMPANY • **Worcester, Massachusetts**
Behr-Manning Division—Troy, N. Y.

NORTON ABRASIVES

Keep Your Workers' Eyes Trained on their Work

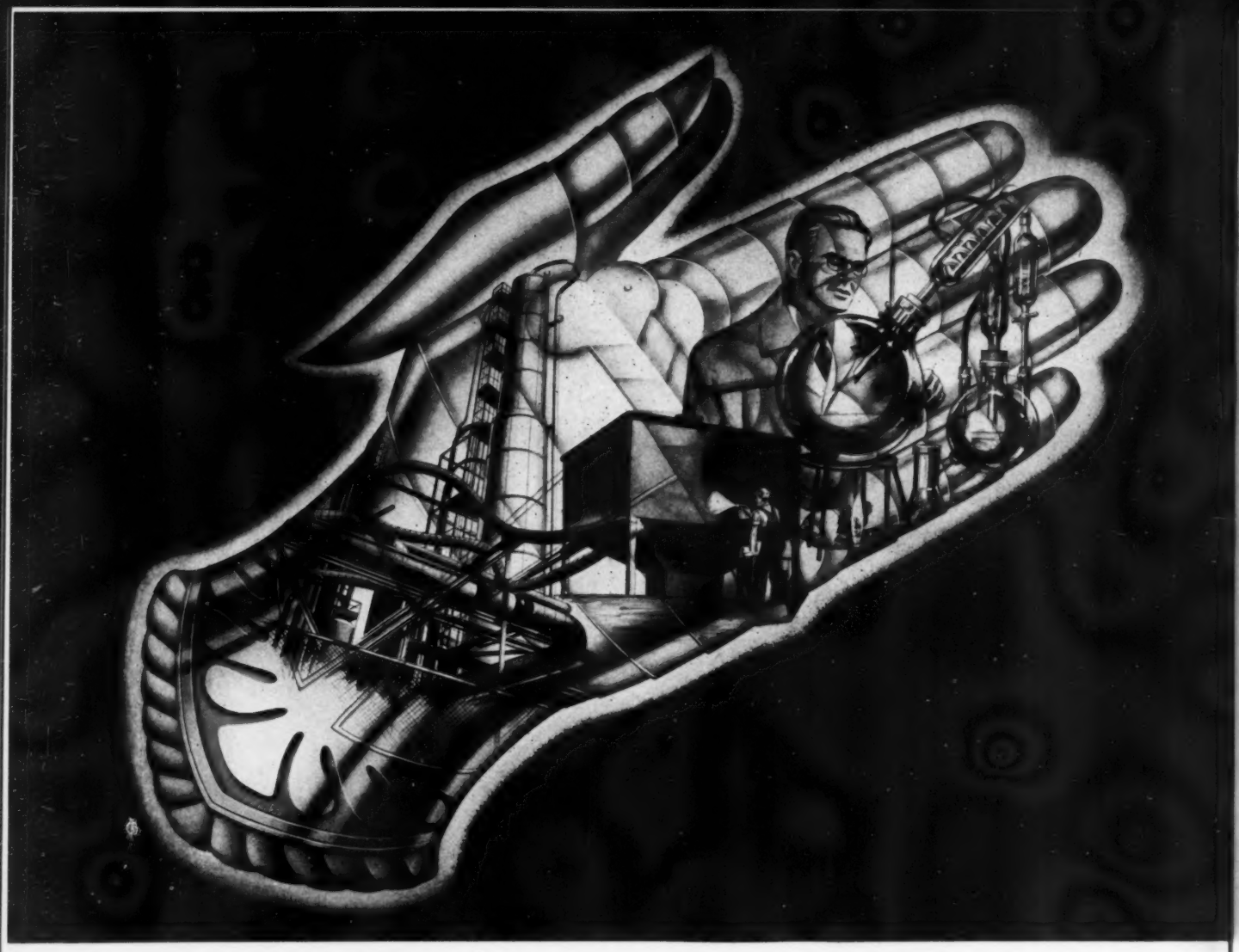
WITH
AMERICAN
OPTICAL
GOGGLES

We need more than our workers' hands to win this war . . . we also need their *eyes*. Yet, for lack of proper goggles, industrial eye accidents are *still* occurring at an alarming rate . . . *still* costing our valiant fighting men much equipment that they need to smash the enemy.

Put on an offensive now to stop eye accidents in *your* plant. American Optical Company, pioneer manufacturer of products to aid and preserve vision, offers you the eye protection equipment and complementary services that your plant needs to protect man-power for war-power. AO Goggles are scientifically designed to give maximum possible protection . . . and workers find them comfortable to wear. Have your Safety Director get in touch with the nearest American Optical Branch Office.

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

THE TECHNOLOGY REVIEW, April, 1943. Vol. XLV, No. 6. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.



TYGON *protects the fingers of the iron fist*

THE mechanical fingers that move America's iron fist must not be stilled for a single moment . . . from these fingers flow the planes, the ships, the tanks, the guns, on whom victory depends.

There dare be no joints stiffened by corrosion! These moving fingers must be kept free!

Tygon, one of America's newest and most versatile materials, is effectively aiding designers and engineers everywhere in retarding the action of corrosion on buildings and plant equipment. In arsenals and shipyards, in airplane and tank factories, in chemical and metallurgical plants, the life of irreplaceable machines and equipment is being indefinitely prolonged through the use of Tygon anti-corrosive protection.

For Tygon is unaffected by more than 90% of the corrosive elements which play hob with industry. The chemicals that work havoc with metals, that quickly destroy steel, that eat through glass, have little effect on this amazing synthetic. Sun, air, moisture, and time—levelers of most material things—leave Tygon virtually untouched.

Tygon possesses the rare virtue of "flexibility of application," retaining its basic corrosion-resistant properties through a wide range of physical forms. It is made into flexible, resilient sheets for tank linings or for gasketing; into liquid for use as a paint or for impregnation of porous materials; into light, flexible tubing, or into easily machined solid rods. Tygon may be readily molded into intricate shapes possessing excellent tensile strength plus remarkable durability and corrosion-resistance.

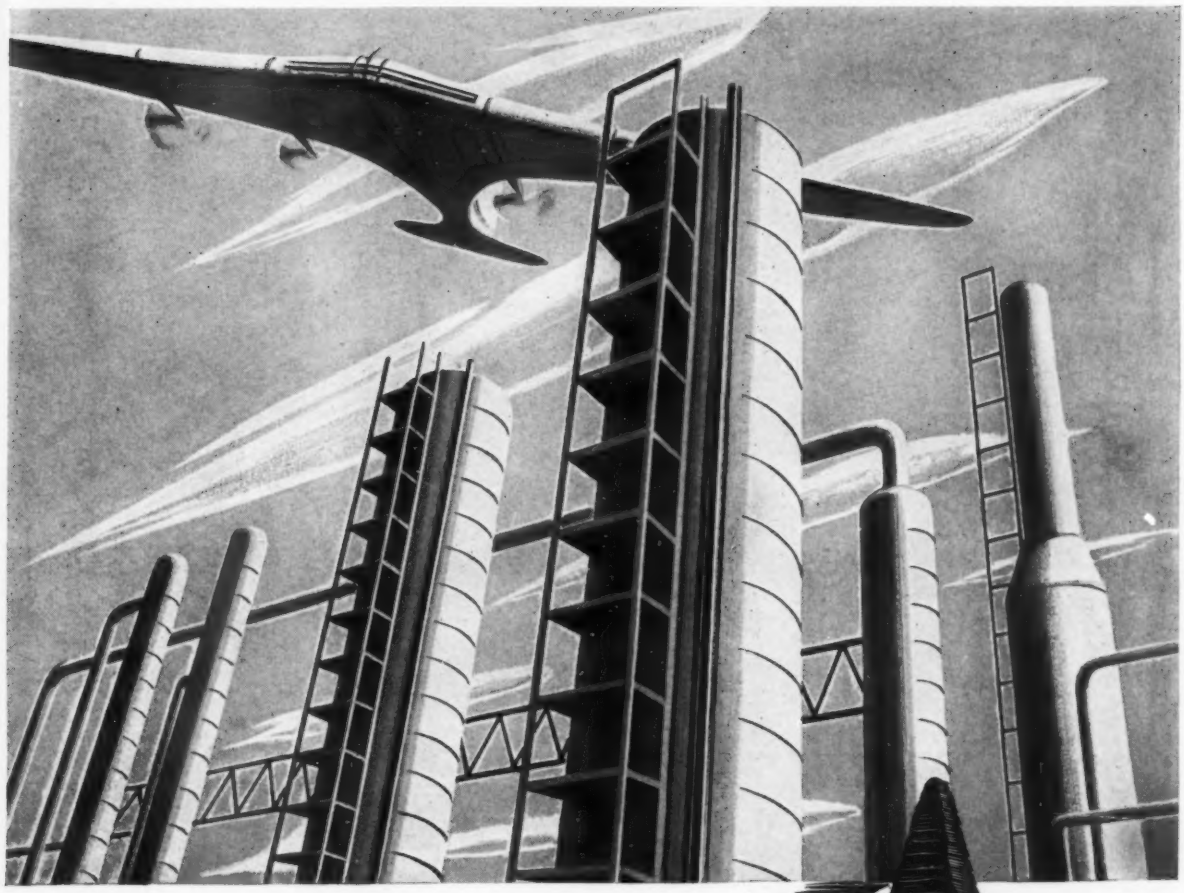
Would you like to learn more about this versatile material? Write today for Bulletin 1621.

U. S. STONEWARE

AKRON, OHIO

IN CANADA: CHAMBERLAIN ENGINEERING, LTD., MONTREAL

ENGINEERS • MANUFACTURERS • ERECTORS OF CORROSION-RESISTANT EQUIPMENT



Looking ahead from a long way back

From the early days of "Colonel" Drake and "Coal Oil Johnny," the chemistry of oil has been destined for great things. Greater even than the high-octane gasoline which today is propelling planes across the sky at 400 miles per hour. Greater than butadiene and toluene.

So, too, with the chemistry of alcohols, phenols, esters, ketones and other organic compounds.

The greater things are sure to come. Many are already germinating—secretly in some instances—and inevitably heading toward enriching the world of tomorrow.

It takes background and experience to put into successful production the products chemical research has perfected. It takes far-reaching facilities to design and build processing equipment that can be expected to operate efficiently.

Badger perspective looks through four generations toward process engineering and plant construction in many future fields. Though busy on gasoline, rubber, T.N.T. and other war-aid projects, Badger is nevertheless preparing for post-war undertakings. . . . Manned with engineers, designers and draftsmen to convert the new miracles of science into realities. . . . Equipped to plan, build, and to supervise the initial operations of complete manufacturing units.

E. B. Badger & SONS CO.

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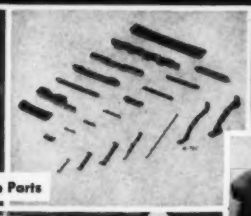
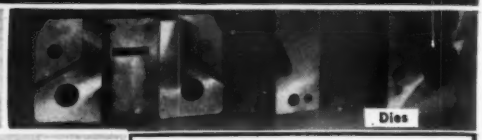
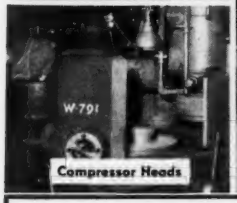
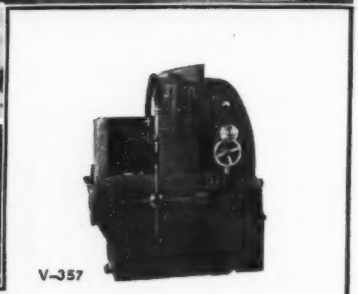
PROCESS ENGINEERS AND CONSTRUCTORS FOR THE CHEMICAL, PETROLEUM AND PETRO-CHEMICAL INDUSTRIES

"PUT IT ON THE BLANCHARD"

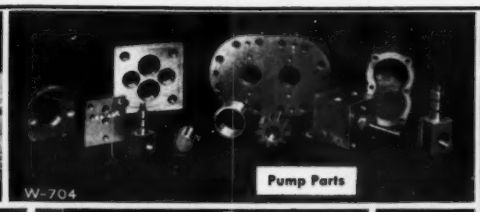


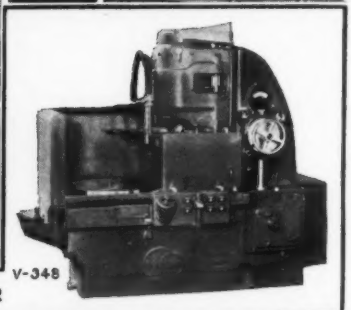






EXAMPLES OF WORK DONE ON THE NO. 11 BLANCHARD SURFACE GRINDER





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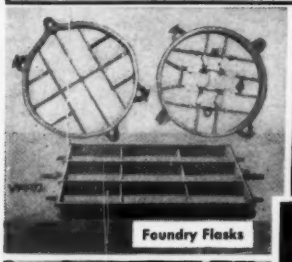
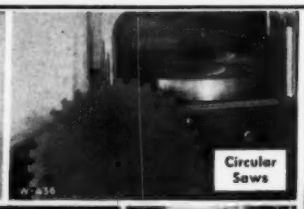
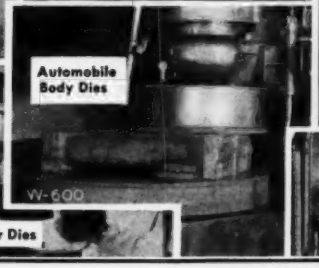
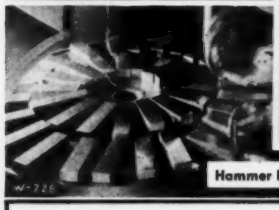
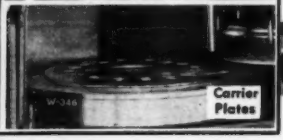
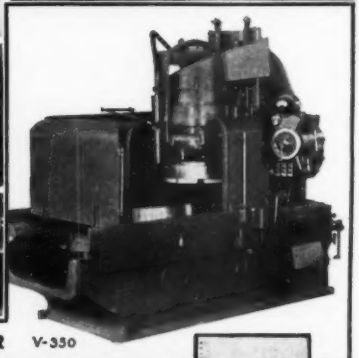








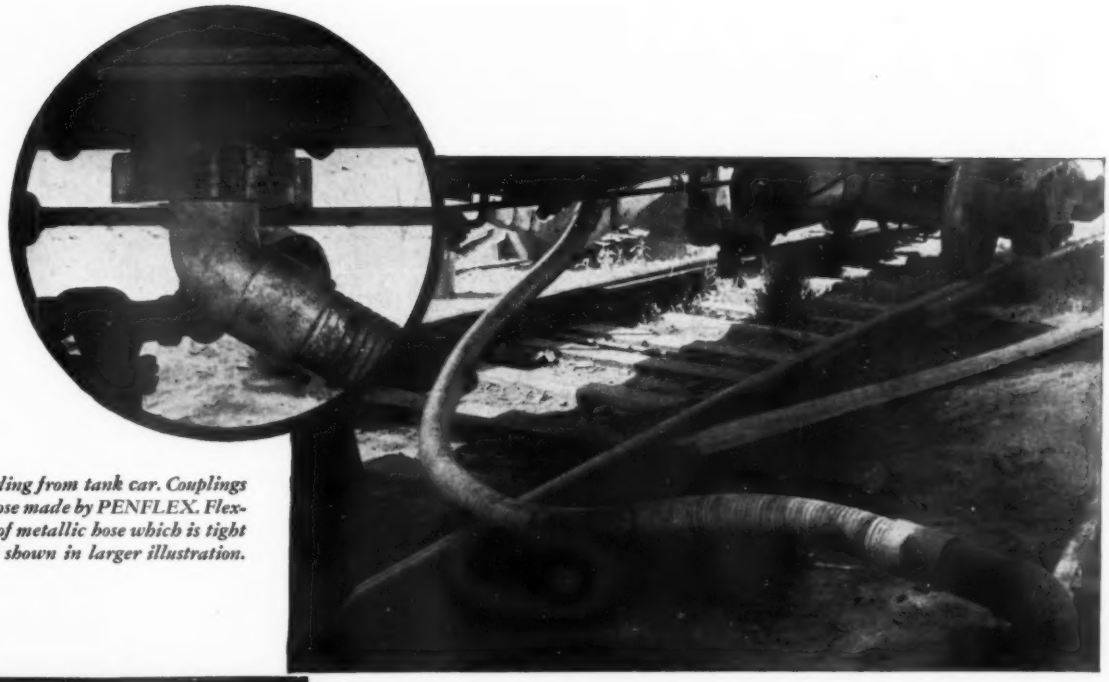




EXAMPLES OF WORK DONE ON THE NO. 27 BLANCHARD SURFACE GRINDER

The **BLANCHARD** MACHINE COMPANY

64 STATE STREET, CAMBRIDGE, MASS., U. S. A.



Unloading from tank car. Couplings and Hose made by PENFLEX. Flexibility of metallic hose which is tight as pipe shown in larger illustration.

Four-Wall Interlocked Construction in sizes 1" to 18" I. D. In various metals and alloys . . . coated and uncoated.

Here is Hose to Handle *Styrene* and other Synthetics

"Double interlocked type hose is best suited for handling Styrene since it contains what is commonly known as a benzine ring." So states a letter from a large synthetic rubber manufacturer who ought to know, since he also manufactures other mechanical rubber products.

PENFLEX is wound in a continuous helix, from strips of heavy metal which resists attack from a wide range of liquids. Four metal walls—*tight as pipe*—reduce danger of puncture; four metal walls interlock to resist crushing.

Great flexibility, accomplished by PENFLEX sliding, interlocking joint construction—*the metal itself does not bend*—provides freedom from kinks.

Perhaps you, too, have an unusual problem in handling liquids. If so, write our engineering staff. You can get helpful data and information gathered through 40 years' experience in research and manufacture of flexible metallic hose and tubing.

PENFLEX METAL HOSE

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.

7211 Powers Lane, Philadelphia, Pa.

ESTABLISHED 1902

Up there alone, hobnobbing with the scudding clouds in the white-flecked azure, what's in the back of his mind, while he scans an ocean monotonously empty?

There are long and glamorless stretches to patrolling. Plenty of time to think—in a detached way that doesn't distract his watchful eyes from sea or instrument panel..... Plenty of time to see a sunlit street, a campus path, a breath-catching moment of bashful ardor under a genial moon. Whatever the image, it stands against the background of coming home to opportunity, to work, to fulfillment.

And that's what it will be if production is pushed, if paydays are bond-days and if spare hours are devoted to plans for supplying post-war markets—and thereby a job and home for this boy.

It's his due ..... There'll be a hunger for the goods we've done without, but they'll not be identical goods. They'll be improved or entirely new. Made, quite probably, with machines that have yet to be built—machines that are typical of American ingenuity—perhaps even like some of those developed and made here at FIDELITY and described in "Facilities."

Write for a copy of this illuminating book.

ARMY E NAVY

32 YEARS' EXPERIENCE

Designers and Builders of Intricate, Automatic Precision Machines

FIDELITY MACHINE COMPANY

3908-18 FRANKFORD AVENUE, PHILADELPHIA, PA.

Wartime readjustments . . . #7

NEVER AGAIN WILL BILL COLEMAN TRY TO BUY A TRAIN TICKET AT THE LAST MINUTE!

The trip is urgent, the line is long, and the time is short. Bill's at the end of the line, and almost at the end of his patience.

He should have known better. You can't put things off in wartime and expect them to go smoothly. You've got to plan in advance — whether you are buying tickets or life insurance.

Remember that insurance premium dollars go to work for America and promote the war program, directly or indirectly, in every vital field. So that, if you do plan your insurance program now, you can increase your war contribution and your family's protection at the same time. If you wait, war strain or accident may make you uninsurable.

Taxes, War Bonds, life insurance . . . these three are basic in all budgets now. These three help win the war and check inflation. Whatever readjustments they require are well worth while. Any New England Mutual representative will be glad to help you — with friendly, practical suggestions that will make every dollar do its wartime duty.

New England Mutual contracts meet present-day needs because:

1. **DIVIDENDS** begin at the end of the *first* year.
2. **CASH VALUES** begin at the end of the *second* year.
3. **A PREMIUM LOAN** is available beginning with the *second* annual premium.

Let a Career Underwriter show you how valuable these features can be

New England Mutual

Life Insurance Company of Boston

George Willard Smith, President *Agencies in Principal Cities Coast to Coast*

The First Mutual Life Insurance Company Chartered in America—1835

Don't put off life insurance, either!

Traveling, marketing, remodeling — almost *anything* you do in wartime must be planned in advance — or you're out o' luck.

That's especially true of life insurance. It takes *very* careful planning to cover the needs that war can create—or to provide for the financial adjustments that may be necessary. You can be sure of getting the *right* kind of planning *only* from able underwriters.

A number of them are listed below. They're alumni of your college and they talk your language. They are also trained representatives of the First Mutual Life Insurance Company Chartered in America.

Out of their experience you'll get *practical*, constructive suggestions. They'll help you make the most of your limited life insurance dollars — help you protect your present policies with premium loans if necessary. Check your protection *now when you need it most.*

RAYMOND P. MILLER, '18
Salem

▪

ARTHUR C. KENISON, '19
Boston

▪

BLAYLOCK ATHERTON, '24
Nashua

If none of these folks is near you, you can get similar service at the New England Mutual office in your city. Or use the coupon below, and the Home Office will have a competent representative counsel with you. No obligation, of course.

NEW ENGLAND MUTUAL LIFE INSURANCE COMPANY OF BOSTON
Box I-2, 501 Boylston St.
Boston, Mass.

Please have one of your representatives get in touch with me, without obligation on my part.

Name _____

Street _____

City _____

State _____

USE THE DUAL FEED RATE for *Greater* Milling Production —on No. 12s

B·S

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

Double or **halve** the selected cutting feed automatically at any desired point in the cut.

These savings frequently cut production time in half — sometimes more — on your No. 12 Plain Milling Machines.

BROWN & SHARPE

EQUIPMENT FOR THE CHEMICAL INDUSTRIES

Made by ARTISAN from any metal

Autoclaves
With or without agitators
Steam, Dowtherm, Electric or Gas Heated

Condensers and Heat Exchangers
Single Pass and Multipass

Distillation Equipment
Continuous Rectifying
Batch Rectifying
Steam Distillation
Plain Evaporative

Evaporators
Horizontal Tube
Vertical Tube
Basket Type
Forced Circulation

Jacketed Kettles
Hemispherical or Standard Dished Heads

Pipe, Pipe Coils, and Bends
Large fabricated pipe, particularly copper, monel, and stainless steel. All types of processing piping
Pipe coils — in any metal — helical, zigzag, pancake, from all sizes of pipe and tubing

Reactors
Plain, jacketed, or with coils. Agitated — horseshoe, turbine, or paddle-blade type

Tanks
All types and sizes

ARTISAN METAL PRODUCTS INC.
20 SULLIVAN SQUARE BOSTON, MASS.
JAMES DONOVAN '28, *Treasurer and General Manager*

THE TABULAR VIEW

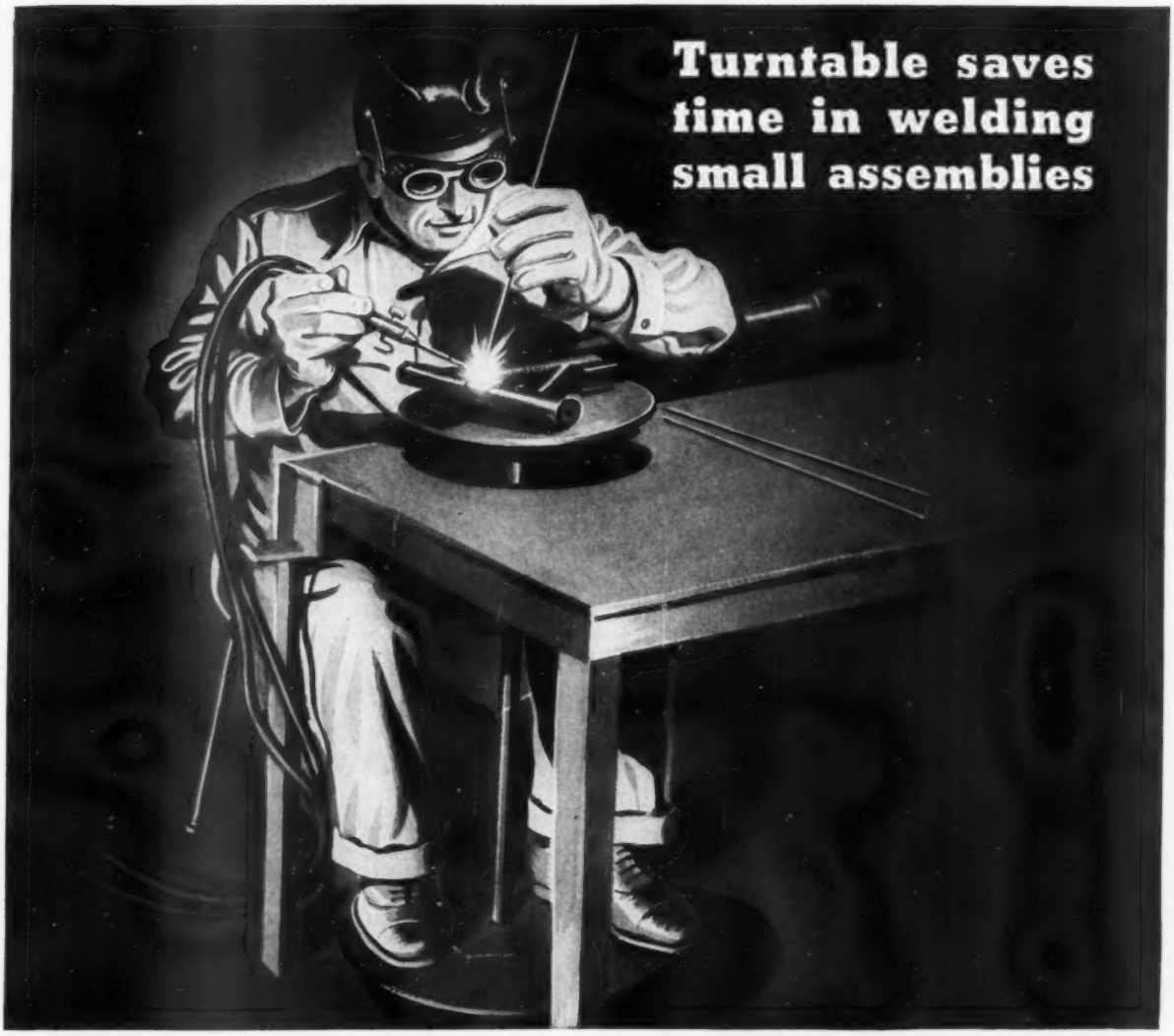
Limits and Logic. — Dealing vigorously with a subject whose usual vital importance is enhanced by wartime conditions, the address delivered by ROBERT E. WILSON, '16, at the time of his receiving the 1943 Perkin Medal of the Society of Chemical Industry, is a trenchant discussion of various proposals for revision of the American patent system. The address has appeared in full in *Industrial and Engineering Chemistry*. Through the courtesy of the Society of Chemical Industry and of the American Chemical Society, holder of the copyright, The Review commences in this issue (page 307) an article drawn from Dr. Wilson's text. His appraisal of the values in our present way of correlating the interests of inventors and of society by means of a system of limited monopoly, and his analysis of the logic of constituted limits as opposed to sundry plans for compulsory licensing and other devices, are penetrating. Formerly director of the Research Laboratory of Applied Chemistry at the Institute, Dr. Wilson, who is president of the Pan American Petroleum and Transport Company, is himself an inventor holding numerous patents on chemical and engineering processes.

Bear Believers. — From NEILL JAMES, who lived among them in 1940 on the island of Hokkaido off the coast of Siberia, comes a description (page 310) of the Ainus, white aborigines whose present status is a measure of the ability, or lack of it, which the Japanese possess as overlords of a colonial empire. Miss James, whose delight is adventuring hither and yon, last wrote for The Review in December, 1941, reporting on her observations of the Laplanders.

Accommodation. — Adjustment of the economic structure of a nation to the appearance of new products is discussed in this issue (page 313) by RALPH E. FREEMAN, Professor of Economics and Head of the Department of Economics and Social Science at Technology. Widely experienced in practice as well as theory, Professor Freeman writes understandingly of problems which industry and society must expect to confront after the war.

Life. — From his variegated investigations, M. F. ASHLEY MONTAGU, anatomist, anthropologist, and generally interested observer, writes (page 315) on the attitude of science toward war as it has been expressed by noted scientists of centuries past. Professor Montagu is a member of the faculty of the Hahnemann Medical College and Hospital of Philadelphia.

Spinners. — Spring's coming on brings with it manifold interests for the observant. One of these is recounted for The Review (page 304) by CHARLES H. BLAKE, '25, Associate Professor of Zoology at the Institute, whose Thoreauvian cast of mind fits him well for the undertaking.



Information supplied by an Industrial Publication

Several means are being applied industrially to save time and reduce fatigue of welders working on heavy jobs. Positioning tables, rotating jigs and similar devices for handling heavy or bulky assemblies are quite generally used.

One aircraft manufacturer has adopted a similar idea for welders working on small sub-assemblies. The assemblies are light, and joints are usually quite accessible. But moving the assemblies by hand does occasion some delay.

This is obviated by mounting the work on a small turn table somewhat resembling an old style potter's wheel. The turn table is quite simple, consisting of two round plates mounted on a common shaft.

The upper plate carries the work, and is located at a convenient height above a work table. The lower plate is a few inches above the shop floor. It is positioned so that the operator's feet rest on it comfortably.

Thus, when the operator wishes to move the work, he simply "indexes" the lower table by foot power. The weight of his feet on the plate is, however, sufficient to hold the whole turn table steady while he is welding any particular joint.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE BRIQUETTES • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

BATH
IRON WORKS
CORPORATION

Shipbuilders and
Engineers

•

BATH, MAINE

TRADE MARK
HEVI DUTY
REGISTERED U.S. PAT. OFFICE

Hevi Duty Electric Co.
Electric Furnaces
MILWAUKEE, WISCONSIN

Hevi Duty Precision Electric Heat Treating Furnaces are built in a large variety of types and sizes — for many heat treating operations — with temperature ranges to 2500° F. (1371° C.). They are standard production equipment in many national industrial plants.

Write for descriptive bulletins

GEORGE A. CHUTTER, '21
District Manager
90 West Broadway
New York

ELTON E. STAPLES, '26
District Manager
205 W. Wacker Drive
Chicago, Ill.

MAIL RETURNS

Devoured

FROM MAJOR ROBERT E. MATTSON, '26:

The November issue of The Review, which you sent me direct, arrived in the Middle East the first of February, and I have been devouring it ever since. It is the first American periodical that I have seen since I left the "old country," and therefore it was doubly welcome. Thanks a lot for sending it. I shall turn it over to Bill Drummey, '16, when I finish it, and that means *really* finish it, even to all the class notes. . . .
A.P.O. 523, Care of Postmaster, New York, N. Y.

Corroboration

FROM FRANK S. MACGREGOR, '07:

I have just finished reading the article, "Unconscious Ambassadors," in your February issue. I feel that Mrs. Dodge is much too modest in writing her second paragraph, for I have lived five years in South America and find that her article applies just as well to that part of the Americas as it does to Central America. In fact, many of her comments and experiences are exactly the same as my own observations and experience. I hope that the article will have quite a general reading, particularly under present-day efforts to make the United States "Central and South America conscious."
Wilmington, Del.

Not through Free Gift

FROM WILLIAM A. RHODES, '12:

We read a great deal about new materials and new products which various firms have under development for the postwar world, and "Design Futures" by Clarence P. Hornung in the February Review is close to tops.

There is also, it seems to me, another subject beside the strict consideration of material things to which the business administrators of producing firms might equally well attend. For a determination seems to be growing throughout the world that, after the war, poverty and privation no matter where encountered are no longer to be tolerated. Consequently, any industrial postwar committee — and I imagine most firms have them by this time — might consider in relation to industrial operations and output (1) the abilities peculiar to impoverished peoples who, even aside from their willingness to work for low pay, are, for example, the best repetitious workers at simple tasks; and (2) the sort of goods which impover- (*Concluded on page 322*)

Speed with Economy

Goodyear Tire & Rubber Co.

Our work ranges from small units to buildings of over a million dollars each. And it includes all types of construction — concrete, brick and steel, timber, etc.

W. J. BARNEY CORPORATION
101 PARK AVENUE, NEW YORK
INDUSTRIAL CONSTRUCTION
Alfred T. Glassett, '20, Vice President

The Goblin that works for America

THE INQUISITIVE alchemists of the Middle Ages were looking for silver. Repeatedly, they smelted certain ores and got a silvery-looking metal. But it was only *silvery-looking*. It never turned out to be silver. So the alchemists thought that a malicious spirit was thwarting them, and they called the strange metal Kobold, meaning goblin.

Today that same goblin, known in America as cobalt, has become one of this country's great fighting elements. Cobalt is alloyed with chromium and tungsten to make "Haynes Stellite" alloys which have the property of "red hardness." Metal-cutting tools made of these alloys keep on cutting even when red hot! Cobalt improves red hardness and toughness in other kinds of metal-cutting tools. Thus, cobalt has contributed greatly to the tremendous output of planes, tanks, guns, and other war materials.

Cobalt is also used to produce improved magnet steels. Permanent magnets of cobalt-tungsten steel are more powerful, and last longer. Permanent magnets are necessary in much electrical equipment.

This country's cobalt formerly came from Belgium, where it was refined from African ores found in the Belgian Congo.

As war clouds loomed, and as accelerated American industry made rapid inroads on the stockpiles shipped out of Belgium during 1938 and 1939, ELECTRO METALLURGICAL COMPANY, a unit of UCC, designed and built facilities in this country for the Belgians. ELECTROMET now operates these facilities so that HAYNES STELLITE COMPANY, another Unit of UCC, and other American companies can have the cobalt they need for essential war work. Operations began in 1941. Today, these facilities annually produce more cobalt than was ever imported in any year previously.

BUY UNITED STATES WAR BONDS AND STAMPS

RED HOT...STILL CUTTING! Faster production of metal equipment of all kinds is made possible by high-speed metal-cutting tools containing cobalt.

SIGHTED SUB! Better radio transmitting tubes and improved electrical equipment are assured by cobalt.

CALLING HEADQUARTERS! Telephones and other electrical equipment require permanent magnets. The better magnet alloys contain cobalt.

WEAR-FIGHTER! Planes fly farther with fewer repairs, thanks to exhaust valves protected with "Haynes Stellite" cobalt-chromium-tungsten alloys.

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York, N. Y.

Principal Products and Units in the United States

ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS AND BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

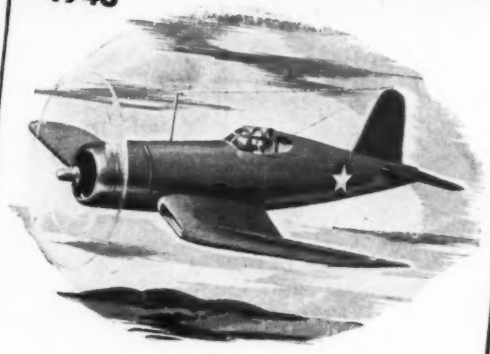
Trail Blazing in the Skies

1924

THE FIRST U.S. NAVY AIRPLANE

to be built with duralumin structural members was the Martin MS-1, produced in 1924. These members were formed by Goodyear for the Glenn L. Martin Company. This important work was entrusted to Goodyear because of our previous experience in building duralumin keels for military airships – the first use of this metal-alloy by any private aircraft manufacturer in the United States.

1943



THE FASTEST NAVY AIRPLANE

in service today is this Corsair fighter. This airplane is now also being built by Goodyear from specifications of the Chance Vought Division of United Aircraft Corporation, the Goodyear version being designated as the FG-1. Into the building of this all-duralumin ship goes all of Goodyear's long experience in fabricating metal aircraft structures. Although it is faster, longer-ranged and more powerfully armed than any other Navy fighter now in action, its weight is remarkably low for all that is packed in it – proof of superior design and construction.

GOODYEAR

GOODYEAR AIRCRAFT

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Seterin from Three Lions

The master's machete gets a ride thus in Costa Rica.

VOLUME 45 NUMBER 6

THE TECHNOLOGY REVIEW

TITLE REGISTERED U. S. PATENT OFFICE

EDITED

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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From a photograph by Claude E. Patch, '02

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Relating to the Massachusetts Institute of Technology

Published monthly from November to July inclusive on the twenty-seventh of the month preceding the date of issue, at 50 cents a copy. Annual subscription, $3.50; Canadian and foreign subscription, $4.00. Published for the Alumni Association of the M.I.T.: Francis A. Barrett, President; Harold Bugbee, Edwin D. Ryer, Vice-presidents; Charles E Locke, Secretary; Ralph T. Jope, Treasurer. Published at the Rumford Press, 10 Ferry Street, Concord, N. H. Editorial Office, Room 3-219, Massachusetts Institute of Technology, Cambridge, Mass. Entered as second-class mail matter at the post office at Concord, N. H. Copyright, 1943, by the Alumni Association of the Massachusetts Institute of Technology. Three weeks must be allowed to effect changes of address, for which both old and new addresses should be given.

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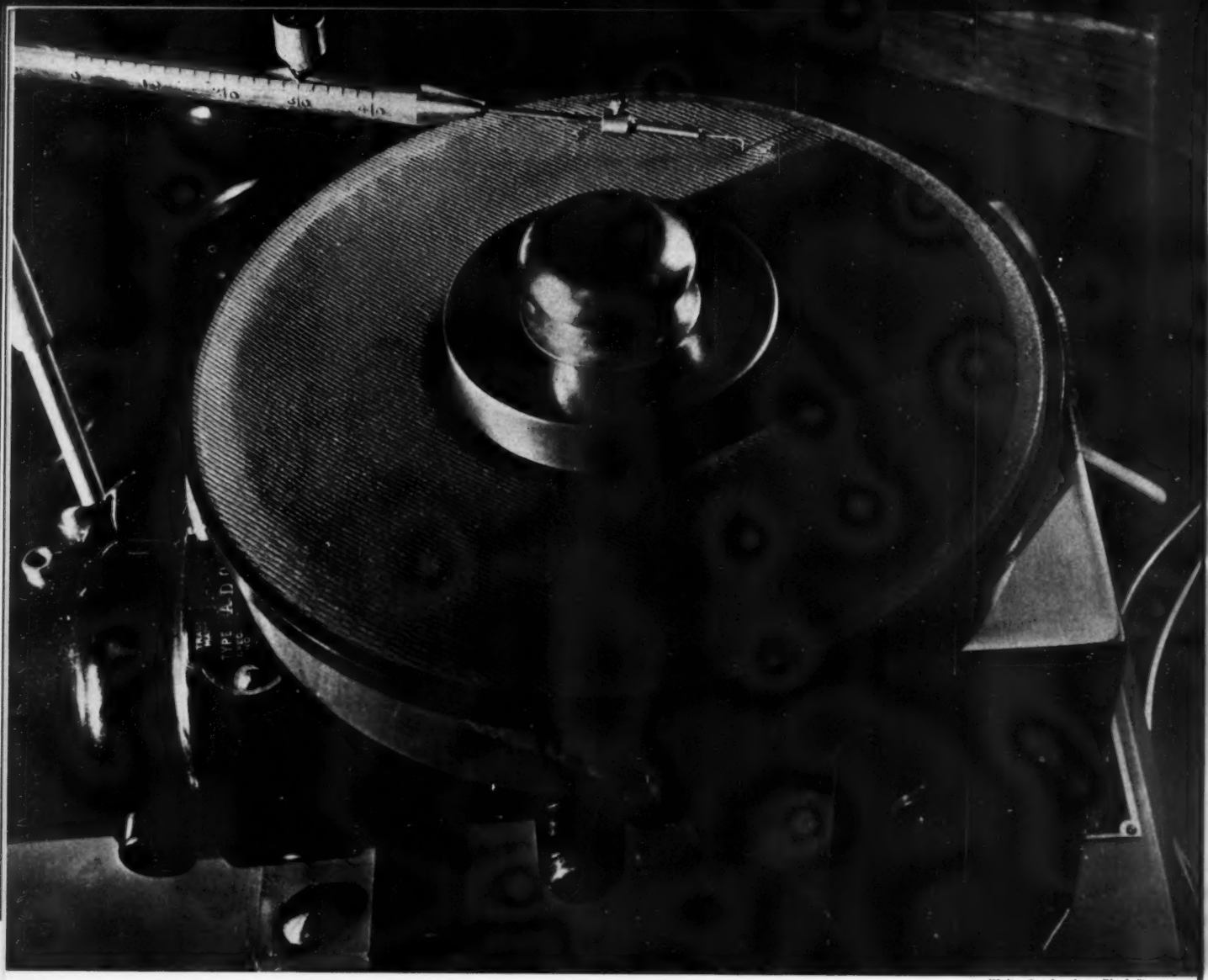


Walter Sanders from Black Star

But how about runs? The serviceability of fabric knit from synthetic textile fibers is tested by this machine.

THE
TECHNOLOGY
REVIEW

Vol. 45, No. 6 April, 1943

The Trend of Affairs

Two Centuries After

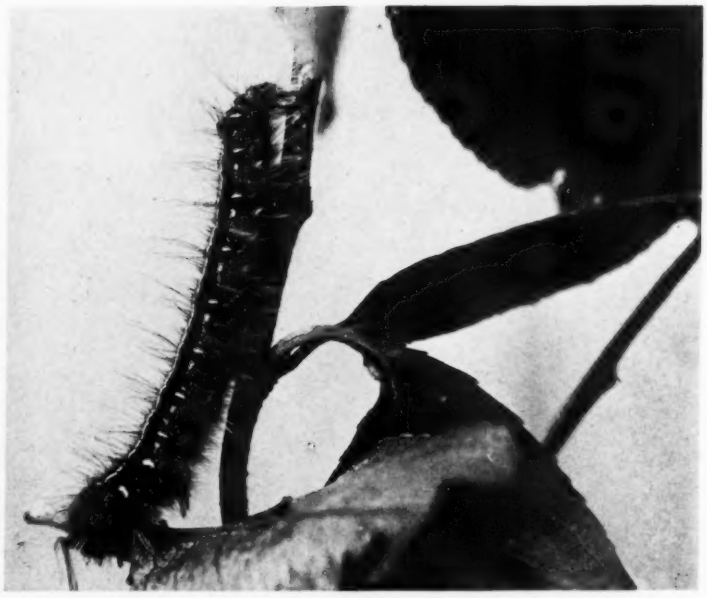
THIS month the people whose independence he declared and whose rights he safeguarded will dedicate a memorial building to Thomas Jefferson, third President of the United States and, with Franklin, first among her citizens in breadth of wisdom and range of human sympathy. The 200th anniversary of his birth on April 13, 1743, gives occasion for the establishment of this physical symbol of Americans' honor to him. Impressive and appropriate as it is, however, the Jefferson Memorial in Washington must be regarded in this year of war as only a slight and transitory thing in comparison to the realities through which the mind and heart of Thomas Jefferson have spoken to his countrymen down the years, and continue to speak.

In the Declaration of Independence, the Statute of Virginia for Religious Freedom, and the Bill of Rights, Jefferson long ago asserted and re-emphasized the four freedoms of the Atlantic Charter. In his care for the establishment of the University of Virginia, capsheaf of the system of public instruction which "as it was the earliest so it will be the latest, of all the public concerns in which I shall permit myself to take an interest," he substantiated by action his faith in the people as the only "safe depositary of the ultimate powers of society."

But Thomas Jefferson was not only philosopher and statesman. As architect, scientist, and engineer as well, he rejoiced in the exercise of intelligence, and in these undertakings likewise was not content with mere theorizing and closet practice. It was not enough, for him, to study and understand; to do and produce as expression of that understanding had necessarily to follow. Yet the organic unity of his life held all these activities in just relation to each other, so that the philosopher and statesman could and did speak even while the engineer and craftsman were at work.

This ordered fullness that marked Jefferson's life appears succinctly in a letter published in the *Transactions* of the American Philosophical Society, setting forth the requirements for the moldboards of plows. Toward the end of the paper, he commented on the then inchoate Napoleonic Wars: "I am fixed in awe at the mighty conflict to which two great nations are advancing, and recoil in horror at the ferociousness of man. Will nations never devise a more rational umpire of differences than force? Are there no means of coercing injustice more gratifying to our nature than a waste of the blood of thousands, and of the labor of millions of our fellow-creatures . . . ? Had the money which has been spent in the present war been employed in making roads and conducting canals of navigation and irrigation through the country, not a hovel in the remotest corner of the Highlands of Scotland, or mountains of Auvergne, would have been without a boat at its door, a rill of water in every field, and a road to its market town. Had the money we have lost by the lawless depredations of all the belligerent powers been employed in the same way, what communications would have been opened of roads and waters!"

In a paper read before the same society last fall, Dugald C. Jackson, Professor Emeritus of Electrical Engineering at Technology, speaking of this passage from Jefferson's moldboard letter, observed: "Thus Jefferson in 1798! Our today's paraphrase of the sentiment may be in nearly the same words, notwithstanding the increased population and the tremendously increased total wealth now in the world. Indeed, the increase in population and total wealth should make us more emphatic. The anthropologists tell us that fundamental changes of the human mind are deadly slow. The present state of the world makes demonstration. A reader of Tacitus cannot but be impressed that the political corruption and wickedness of the government and the



This is Malacosoma americana, *the eastern tent caterpillar, busy at its job of pruning, as the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, photographs it.*

dominant people of Rome near the opening of the Christian era are paralleled in shamelessness by the Hitlerism cult and its leaders today. Our usual rather superficial picture of civilization is too much founded on descriptions of cultures which were only partial civilizations because they failed to recognize a general mutuality of interest among men.

"Full civilization will come to us only when we have well developed material and intellectual well-being among large groups of people. To get this requires the contributions of engineering, as Jefferson infers. The establishment and maintenance of community life depend on engineering. Ethical and moral needs arise out of community relations to make civilization. Thus, true civilization is dependent on the fruits of engineering, but it cannot be brought to full embodiment any faster than the manifest intelligence of the people leads the procession toward it."

Co-operative Pruners

BY CHARLES H. BLAKE

ONE of the less lovely signs of spring in New England is the appearance of the characteristic white nests of the eastern tent caterpillar, who has western tent-building cousins as well as forest-dwelling relatives who make no tents. In spite of the damage which the tent caterpillar can do to cherries and apples and in spite of the bedraggled appearance of the nests later in the spring, the structures are nonetheless worthy of study. As is well known, they occur always in the forks of the trees and are the work of a large number of caterpillars co-operating without any evident means of intercommunication and without any evident plan of operation. The story will be clearer, however, if we start at the very beginning, which is not the nest but the egg-laying.

The females, which are soft-brown moths with two diagonal white lines across each fore wing, lay their eggs in late July near the tips of cherry branches. They generally choose twigs about half the thickness of a lead pencil, and each mass of eggs, nearly the color of the bark, is a muff surrounding the twig. It contains 100 or 200 elongate eggs arranged radially, the whole cemented together and covered by a varnishlike substance. The eggs remain without any obvious change until about the middle of the following April (the average date at Lincoln, Mass., is April 23), when all the eggs in a mass hatch almost simultaneously.

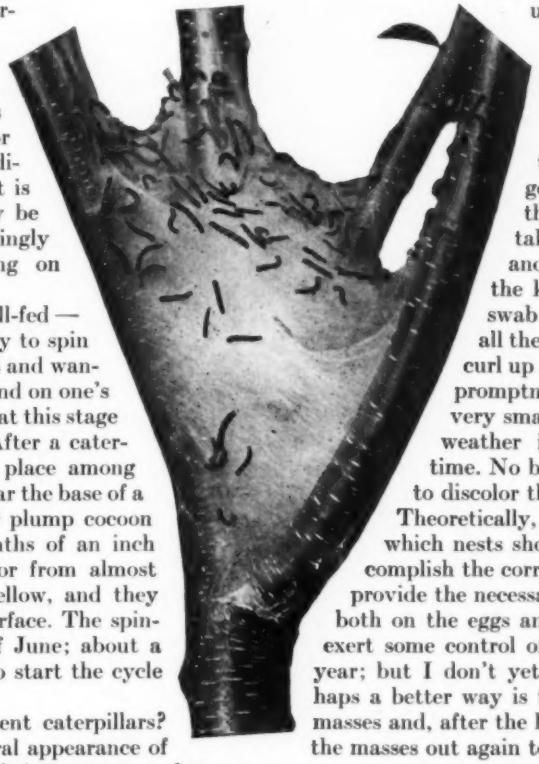
The time of hatching is determined apparently by the average temperature over a few preceding days. In any event, the time is so adjusted that the cherry leaves have just begun to unfold and generally have not exceeded three-fourths of an inch in length. Evidently, then, the young caterpillars find a tender source of correct food ready and waiting for them. It is rather interesting that a large number of observations on diverse insects agree that insects usually do not feed or grow at temperatures below 50 degrees Fahrenheit, and agreement is pretty general that the beginning of plant growth is at about 43 to 45 degrees. This fact suggests that the long association of insects with plants has led to a very neat adjustment which prevents insects from becoming active before the plants on which they would feed are also in growth.

To get back to our caterpillars, whom we left looking for their first meal — they proceed to crawl along the stem and feed on the new leaves. Each caterpillar, as it crawls, trails from its mouth a slender silken thread. Having fed, the caterpillars retreat along the path of silk which they have laid down (usually on the upper side of the branch), and they may go back beyond the egg mass to a fork, where they rest for some time, a few hours or even overnight. Then they follow their line of silk out to the feeding ground again.

After two or three days, during which they may have explored several branches, they begin to spin the tent. The floor of the tent seems to be constructed merely by the caterpillars crawling back and forth in the crotch and leaving their trails of silk everywhere they go. The roof of the tent seems to result from the combined work of all the caterpillars spinning overhead when they throw their heads upward. The roof contains one or more openings through which the caterpillars enter and leave the nest. They make two or three excursions a day to appropriate leaves for feeding. They do not feed at night. As they grow bigger, they obviously require a bigger nest, and according to my own observations they make use of an old roof as a new floor and proceed to spin additional roofs. All of this spinning seems to be done by caterpillars as individuals; but since they all have the same reaction, the effect is as though they had actually co-operated. Eventually the caterpillars are about an inch and a quarter in length,

fairly slender, and provided with long but not very abundant pale hairs. It is a matter of taste whether one shall regard them as handsome or as the reverse.

A large tent in a small cherry tree may result in complete defoliation; and because the flower buds of cherries are terminal structures from the centers of leaf buds, this severe attack wholly prevents flowering. When defoliation occurs, the caterpillars may have to seek other trees for their later meals. Under these conditions the little colony in the tent is broken up and its members may be found wandering about even singly over various plants and feeding on several trees other than cherries.



When the caterpillars are full-fed — after about six weeks — and ready to spin their cocoons, they leave the tents and wander very widely. They may be found on one's pet rose, but they will do no harm at this stage since they have ceased feeding. After a caterpillar has found an appropriate place among some leaves or even in the lawn near the base of a tree, it proceeds to spin a rather plump cocoon about an inch long and five-eighths of an inch wide. These cocoons vary in color from almost pure white to a rather bright yellow, and they have a characteristic crepelike surface. The spinning up occurs about the end of June; about a month later, the moths emerge to start the cycle all over again.

What should be done about tent caterpillars? Granted that they have the general appearance of an unmitigated nuisance, that their nests are often unsightly, and that they do a good deal of actual damage under some conditions, is their record entirely bad? No. In the first place, their feeding on large cherry trees is not entirely deleterious, for they are one of nature's ways of pruning and do diminish the number of flowers, thus making possible a reasonable set of fruit. Apparently none of our fruit trees can ripen as many fruits as it is able to produce flowers, so that some fruits have to be got rid of somewhere along the way.

Again, the unsightliness of the nests is not improved by the customary creosoting of them. Furthermore, the eastern tent caterpillars do not particularly attack cultivated cherries or apples if native wild cherries are available. As native insects, they favor the native trees, not the imported orchard stock. In addition they furnish at least a certain amount of food for several species of birds, notably the cuckoo and the Baltimore oriole.

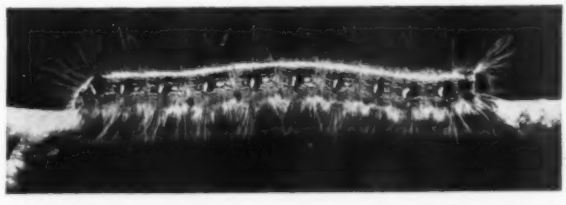
For several years I have tried the experiment of very complete control on my own place. The results have not been entirely beneficial. The number of nests has not noticeably declined over a five-year period. Of course, I do not control the tent caterpillars on my neighbors' places. A much more interesting result has been that, though my wild cherries have flowered abundantly, they have set practically no fruit, and what they have set has ripened very poorly. Further, the lack of natural pruning of the lower branches of the taller trees has resulted in excessive growth of the lower branches, which are ordinarily the ones that are most thoroughly pruned as a result of the caterpillar's ministrations.

My respects having been paid to the creosote method of control, which is ordinarily undertaken too late to save the flowers, it is only fair to divulge my own procedure. It is my habit to watch carefully for the first signs of tent construction. In so doing, I catch a good many colonies before they have even started. Then, taking a swab on a short stick and a small amount of one of the kerosene-base fly sprays, I swab each of the new nests and all the caterpillars I can see. They curl up and die with commendable promptness; the nests, which are very small, are disintegrated by the weather in a comparatively short time. No black, tarry residue remains to discolor the trees.

Theoretically, one should figure out just which nests should be left in order to accomplish the correct amount of pruning and provide the necessary parasites — which prey both on the eggs and on the caterpillars — to exert some control of the species from year to year; but I don't yet know how to do it. Perhaps a better way is to cut off some of the egg masses and, after the hatching of the worms, put the masses out again to release the parasites.

The Scientific "Emily Post"

A RECENT article in *Applied Anthropology*, a journal not long out of its first volume, relates with relish the sad tale of the British administrators who tried to reform the dietary habits of some natives on Bougainville, one of the Solomon Islands. At the moment, the natives are still unreformed and will undoubtedly remain so until the Japanese are driven from the island. The natives living in the mountains subsist almost entirely on taro, as the result of which they suffer from serious dietary deficiencies. Those living nearer the coast eat a wider variety of foods, including pork, but would still benefit from a broader menu. An official therefore visited the regions, harangued the population on the



The familiar tent of the eastern tent caterpillar is shown above on this page, and here is Malacosoma *right out straight. Photographs again from the Bureau of Entomology and Plant Quarantine.*

Paul M. Wiswall, '09

"But westward, look, the land is bright" — Canterbury Cathedral under lowery skies

evils of their too prevalent use of starchy foods, and left seeds and gardening instructions with the chiefs. Some, but not all, groups among the coastal natives planted the seeds. Among the mountaineers nothing whatever happened.

As the narrator comments, with an almost visible smile of satisfaction: "If the official had troubled to discover that women, not men, were the gardeners in the taro-eating north, he might have saved himself much trouble. His mistake was analogous to setting up a crocheting school for American business men. . . . He could also have discovered that political leadership is so rudimentary among the mountaineers that no self-styled chief carried prestige enough to put across a food innovation." Among the coastal people, the official would have been more successful had he appealed to the pride which the men of that region take in their skill in fine cooking, and had he chosen with more astuteness the leaders to whom he gave the seeds. Altogether, he lacked sufficient anthropological knowledge of the natives to succeed in his mission. But the moral has far wider implications.

The need for knowledge of man and his ways is so ancient and so acute that it could not wait for the establishment of a science whose object, stated with more hope than accuracy, is the study of man. When this science, anthropology, came into being little more than a century ago, it found such disciplines as history, economics, sociology, anatomy, physiology, and psychology, not to mention the humanities, enjoying squatters' rights on the territory it claimed for its own. Even an etiquette book is an unconscious treatise on cultural anthropology. And overlying all these formalized groupings of data on the antics of Homo sapiens is the painfully and individually acquired knowledge of one's fellows, used clumsily by most of us and with a skill amounting to genius by great statesmen and administrators. In a very real sense, anthropology was applied long before it or any other science existed.

Widespread recognition of the practical value of anthropology, however, is comparatively new. It arises not from the contributions which this science could make in the main theaters of our civilization, among the massed millions of Europe and the Americas, but from the aid which it gives a few countries in controlling native populations so far removed in thoughts and habits from their white administrators that the customary techniques of government are obviously inadequate. To avoid undue overlapping of previously instituted fields of study, the anthropologists have devoted the bulk of their attention to dead or primitive cultures. As public ethics developed to the point where the sufferings of primitive peoples enduring a perhaps inevitable "civilizing" process could no longer be ignored, government administrators began to realize that the esoteric data being gathered by the anthropologist about the political and social organizations, food habits, economic systems, laws, and religions of their charges might be used to make the work of administration easier and to reduce the social disintegration and depopulation which were frequently the initial signs that Western culture had finally arrived. The first person to appoint an official anthropologist is reported to have been the governor of the British Gold Coast in Africa. The Netherlands Government, because of the wide colonial possessions it held and will presumably hold again, and the United States Government, because of its Indian and Eskimauan charges, are also making considerable use of anthropologists or of administrators with anthropological training. Missionaries, teachers, policemen, jurists, and employers of native labor are others who can profit from a formal study of the people with whom they must deal.

The global aspects of this war, and its tendency to choose battlefields in the wildest and most far-off corners of the world, have emphasized the applied value of anthropology. (Incidentally, even Kipling might have boggled at the goings on in New Guinea and the Solomons — bombs instead of blowguns on Bougainville, air fleets over the Bismarck Sea.) A report by Elsie V. Steedman, assistant professor of sociology and anthropology at Hunter College, lists 36 government agencies and other services "secret in nature" which can profitably use persons with a training in anthropology. Anthropologists have prepared handbooks explaining the customs of, and the methods of dealing with, the various peoples our military forces encounter. They have also furnished valuable information on economic matters, for the conventional economist studies only the very special forms of economics typical of western Europe and America. (*Continued on page 338*)

Research and Patents

Lack of Clear Understanding of the Patent Monopoly Is the Greatest Danger to the American System

By Robert E. Wilson

PART I

CRITICS of our patent system generally say that they recognize the necessity of giving some reward to the inventor, although they are vague as to the form which that reward should take and they usually object to giving him even a limited monopoly on what he discovers. The alternative — which would be to try to determine the fair cash value of an invention — is, however, about the most impossible task a government could undertake; it involves, first, appraising the degree of novelty and value of the inventor's contribution before one knows what other inventors may have been doing in the same field and, second, appraising industrial trends many years in advance and deciding whether and how soon some other and better invention will supersede the one in question. Such a task would give pause to a combination of judge, seer, and prophet — and such a man would be too wise to undertake the job.

Whoever first conceived the notion of granting an inventor a limited monopoly in return for public disclosure of his invention had a brilliant idea, because it takes advantage of the fact that every inventor tends to overvalue his own invention, and that no reasonable cash sum would encourage him so much as the thought of being able to control his own invention for 17 years. Furthermore, because the magnitude of the reward is largely dependent on how important the invention turns out to be and on the inventor's intelligence in handling his patent, it is difficult to think of a fairer method. If he tries to charge too much, his invention will be little used and competitive research will be stimulated. In any event the public, at very small average cost, gets three advantages: prompt knowledge of the invention to add to the scientific background on which further research can be based, reasonable assurance that the worth-while inventions will be commercialized, and free use of the invention after the patent expires.

In my opinion the greatest danger to our patent system lies in the lack of clear understanding of both the nature of the patent monopoly and the compelling reasons for granting one to the discoverer of a really new product or process. Some of the misunderstanding arises naturally out of the complexity of the situation, but much is due to a studied misrepresentation of the essential facts by a small group who have apparently undertaken to destroy or nullify our patent system. One of their outstanding methods of confusing the public has been the old-fashioned one of name calling. Thus the right to the exclusive use of one's own invention for a limited period, as provided in our Constitution and enacted into law on the recommendation of that great antimonopolist, Thomas Jefferson, is supposed to be damned by being called a "monopoly." The public traditionally dislikes a monopoly, regarding it as something carved out of the public domain and acquired by an individual. A patent right, however, covers something discovered or created by the individual and is a natural monopoly as long as he can keep it secret. The patent law simply offers him a legally protected monopoly, limited in time, in return for prompt disclosure, so that the information is immediately, and all rights are eventually, *added to* the public domain.

A mere exchange of free cross-licenses and technical information among a group of companies engaged in research in a given field is condemned as a "patent pool" or a "monopoly of monopolies." Even the magazine *Fortune*, evidently under the spell of recent Washington releases, went so far as to picture a patent pool as a jail with laboratory research workers as the prisoners in striped suits and with armed guards shooting escaping prisoners.

If an American company, in order to get the right to manufacture under an important patent granted by our government to a foreign owner, had to agree to confine its operations under the patent to the United States, it is charged with participating in a cartel; and if war develops 10 years later, the company is publicly accused of having conspired with our present enemy to deprive our present allies of needed products. A small inventor was accused before the Senate patents committee of blocking the manufacture of an item essential in airplane equipment by refusing to grant licenses, whereas it shortly developed that the device was not essential but merely one of several alternatives, and that the only reason he had not been able to supply his entire demand was the refusal of government officials to permit him to buy the necessary equipment to enlarge his plant.

I do not mean to say that patents cannot be, or have not been, abused, as rights of every kind can be misused. I do believe, however, that a deliberate attempt has been made to discredit our patent system in much of the publicity which has emanated from Washington during the past year or two.

As another example of unfair attacks on patents and inventions, consider the public remarks, before this same Senate committee, which Thurman Arnold made regarding tetraethyl lead. Everyone appreciates the tremendous economic value of this invention and knows the story of the long and brilliant series of researches by Thomas Midgley, Jr., which culminated in the discovery of this antiknock agent that increased by an

amount equal to 75 Boulder dams the total available horsepower of the automobile engines made in 1941. It was also one of two inventions that made possible the 100-octane gasoline which has contributed so much to the air superiority of the United Nations. The discovery was the primary basis for the award of the Perkin Medal to Dr. Midgley in 1937. Mr. Arnold airily dismissed it all with the wisecrack: "Now whether these [ethyl] patents were good, I do not know. It struck me at the time, what else could you do with tetraethyl lead but put it in gasoline? You can't put it in coffee."

Such statements by government officials in key positions are particularly dangerous in complex scientific matters which the lay public cannot appraise. The statement would have been much less dangerous, though no less unsound, if it had been: "Now whether these telephone patents were good, I do not know. It struck me at the time — what else could you do with a telephone but talk over it? You can't play tennis with it."

I hope these examples are adequate evidence that scientists must do their part to educate the public and the lawmakers regarding the essential facts about our patent system. As the first step in this educational process we must escape from what Justice Cardozo has called "the tyranny of words" and try to get at fundamental meanings.

Our patent system was not created to enrich inventors but to benefit the public by encouraging the invention and the development of new and useful processes or products. To secure these benefits, Congress, on behalf of the public, has solemnly offered a monopoly, limited in time, to anyone who will make prompt and full disclosure of a new and useful invention, instead of keeping it secret. If he does not make such full disclosure, the patent is *ipso facto* void. A patent represents an addition to, and not a subtraction from, the public wealth. Under our present laws and decisions a patent cannot be used to fix resale prices, to control unpatented articles used in connection with the invention, or otherwise to extend the monopoly beyond its limited purview. Judicial decisions are steadily narrowing the field of what it is permissible to do under a patent. Nevertheless, a patent is a monopoly, is supposed to be a monopoly, and should not be considered damned by being called a monopoly.

As a matter of fact, a monopoly is not the inherent evil many would have us believe. One of the greatest factors in the early development of America was that our settlers could acquire the ownership of land in fee simple and thus monopolize forever their land, its products, its minerals, and the improvements which they made thereon. No greater incentive to hard work and self-sacrifice has ever been found than this right of a man to own and control the fruits of his labors. No one today questions the social value and fairness of that monopoly incentive, which did so much to extend our geographical frontiers and bring new lands under cultivation. The monopoly granted to the discoverer of a mining claim was likewise largely responsible for the rapid development of our mineral resources. Is it not equally important and valuable to extend our only remaining frontiers — those of science and invention — when to do so we need only offer a monopoly for a short span of years?

Probably the first clear perception of the need for, and justice of, a patent monopoly was in the Statute of Monopolies which the English Parliament forced through in 1623, during the reign of James I, to stop the Crown from granting to court favorites monopolies on everyday commodities of life, such as salt, spices, and playing cards. This statute prohibited all monopolies except those for new inventions and new importations into the realm, and it was the first express recognition of the fact that a man should be entitled to some form of property right in, and protection of, his new ideas and developments. The patent laws of the entire world have sprung from this statute, and the gradual recognition of the great incentive thus created has had much to do with the scientific and industrial progress of the past two centuries.

The experience of this country during the last 150 years has certainly demonstrated that the American patent system has been an outstanding success. It was based on a sound understanding of human nature, and its principles have no more been outmoded than has human nature been outmoded. It has stimulated and supported the natural inventive genius of our people, and has resulted in technical and industrial developments which have made us the envy of all other nations.

Though it might be argued that other nations also have patent systems without getting such outstanding results, the fact is that the American patent system has very real advantages over most of the foreign systems in several respects: For example, it provides that the first inventor, and not the first one who files his application in the Patent Office, is entitled to the patent. This provision encourages a man to take adequate time to appraise his invention, work out the details, and even discuss it with others, without jeopardizing his position as the first inventor, provided that he keeps adequate records. American patents, moreover, are not subjected to heavy taxes or compulsory licensing provisions, which would greatly decrease the practical value of the patent, especially to an ordinary independent inventor, whose financial resources are likely to be inadequate during the early years. Furthermore, the fact that sound patents are generally respected by the responsible business interests of this country increases the market for, and the value of, a patent, in contradistinction to the practices in many foreign countries. As John W. Anderson, an independent inventor of note, has well said: "People seldom plant gardens where thieves abound and police protection is inadequate. Pirates are everywhere and inventors will not continue to invent, nor will small investors support their inventions, if patent rights are not sympathetically protected."

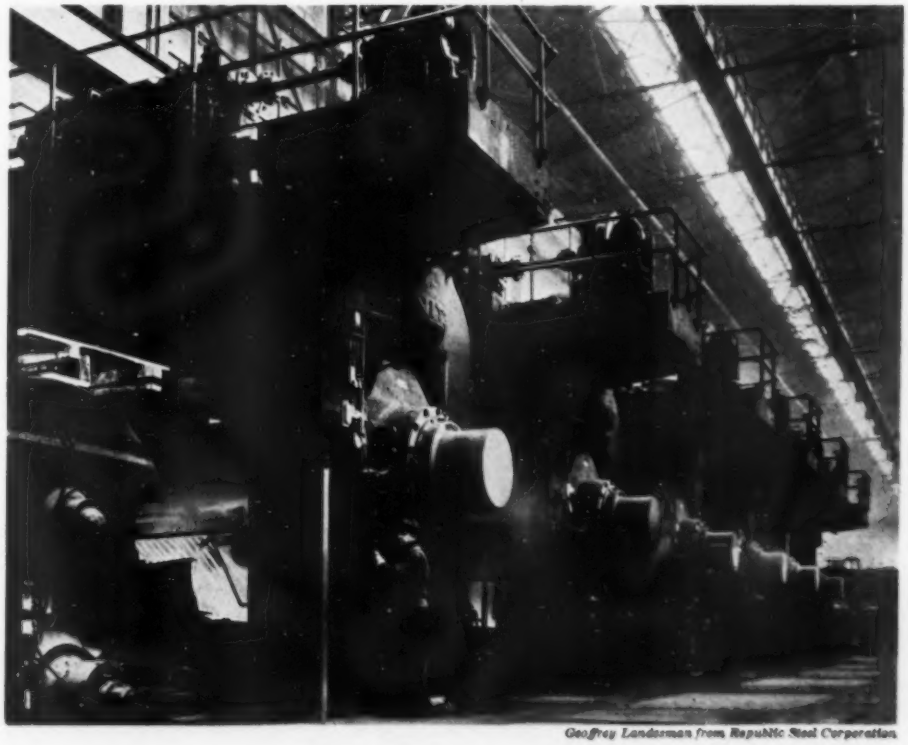
Another object of misinformed criticism is the simple cross-licensing agreement among parties actively engaged in similar lines of research. Because such research generally results in many Patent Office interferences and overlapping patents which would prevent any party from using the best process in sight, there has been an increasing tendency to avoid the expense and delay attendant upon interference and infringement litigation by arbitration of the interferences and exchange of cross licenses covering both past and future developments in a given field, usually on a royalty-free basis.

Such an agreement generally involves provisions for the licensing of others upon reasonable terms and a division of royalties based upon the best estimate of the parties as to the relative value of their respective positions. Usually each party also agrees to conduct further research in the field in question and is left free to license his own patents on such terms as he sees fit.

Despite recent attempts to arouse opposition to such arrangements, all of them being labeled as "patent pools" without any analysis of their provisions, the ordinary cross-licensing arrangement among companies actively engaged in research seems clearly to be very much in the public interest since it facilitates and stimulates research, prevents unnecessary duplication, removes obstacles to prompt commercial development, and avoids wasteful litigation. The free and prompt exchange of ideas and information among rival laboratories is a tremendous accelerator of new developments. Cross-licensing arrangements also make available to an outside licensee all the necessary patents and, what is frequently more important, the combined experience of several companies. Hence he can select and operate the process best suited to his needs without having to acquire licenses and information from several different sources. The only one that could reasonably complain against such an arrangement is the individual or company that hopes to use the new process with impunity while the owners of the patents fritter away the life of their patents in lengthy and often suicidal litigation with one another.

Since cross-licensing agreements of this type tend to promote not only research and invention but the prompt commercial application of the inventions, the question might be raised why free cross-licensing agreements covering entire industries would not be still better. The main difficulty of such arrangements is that they run up against human nature: When some individuals or companies realize that a competitor will have the same rights they have to anything new which they may develop, they frequently decide to leave most of the expense of research and development to the other fellow and hope for a free ride for themselves. Other companies which as a matter of principle continue their research, sooner or later become irritated when the fruits of it are appropriated by those who have contributed nothing. Industry-wide pools also remove the main incentive of any company to pioneer radical new developments, inasmuch as they will quickly be copied by everyone if they prove popular.

While it is true that cross-licensing agreements have occasionally been used as screens for attempts to divide a market or to control unpatented devices, such arrangements are clearly under the prohibition of the antitrust laws and are practically obsolete today, thanks in part to the vigorous activity of the antitrust division. Accordingly there seems to be no reason to legislate against the ordinary and desirable type of cross-licensing agreement which I have described. If a few of the larger companies in a major industry made a cross-licensing arrangement which covered every branch of their business without regard to their respective patent and research positions and which excluded others, the arrangement might be open to criticism; but where, as in the petroleum industry, each new important field of development generally becomes the basis for one or more cross-licensing arrangements with different participants, depending upon who has pioneered in the new field, and where the arrangement (*Continued on page 320*)



A train of hot-mill finishing-stands in a continuous strip steel mill — representative of American industry built on research as fostered by the patent system

Geoffrey Landesman from Republic Steel Corporation

Along the Aleutian Route

Long Mastered by the Japanese, the White Ainus of the Northern Island of Hokkaido Cling to Ancient Customs

By Neill James

WHEN the fortunes of war focused our attention on the chain of islands which links Japan and America, a curious race of white orientals living on Hokkaido, largest island on the direct air route between Tokyo and Fairbanks, came into the limelight. This once powerful, warlike race of white aborigines, the Ainus, were in possession of the island archipelago of what is now Japan before the coming of the yellow man. The earliest writings of the Japanese are replete with accounts of the battles with the Ainus, who fought them fiercely for six centuries, at first with the bow and arrow and later with the sword. Finally, about A.D. 900, weakened by civil war, the Ainus were conquered and pushed north until their last retreat was Hokkaido, northern outpost of Japan. The Ainus are anything but a docile people, but, being only 16,000 strong, they aren't important in the general scheme of empire any more. Today they dwell in peace along the southern shore and up the narrow river valleys, sharing this fertile pioneer island with nearly three million Nipponese settlers.

The once remote but strategically situated Hokkaido, now becoming a hot spot of the Orient, is a sparsely settled and not very well fortified island about the size of Ireland. It contains much potential wealth. In addition to supplying all the horses for the cavalry, 95 per cent of the butter and cheese used in Japan, and quantities of wheat, steel, paper, and lumber, Hokkaido contains vast fields of coal estimated at 140,000,000,000 tons. The terrain is Occidental rather than Oriental in character, with high mountains, active volcanoes, broad sweeping plains cut by rushing rivers, and large tracts of virgin forest land through which some 6,000 wild bears roam.

The smooth-skinned Japanese of small stature has a tradition of fear for the fierce, stocky, hairy Ainu. Even after a thousand years of subjugation, no Ainu today is permitted to possess a complete sword. A cherished heirloom kept as an ornament (of which there are many) must be rendered useless as a weapon by having the blade detached from the handle.

Anthropologists have long puzzled over the enigma of the Ainus, unable to determine whence they came or how white men happened to be inhabiting islands in the Orient some 3,000 years ago. Some believe they migrated from northern Europe across Siberia; others think they came from southern Europe by way of the South Sea Islands. Most agree the Ainus are Caucasian. Despite ten centuries of suppression, the remnants of this remarkable race have doggedly clung to their distinctive culture, mode of dress, native language, and strange religion. The women wear blue mustaches tattooed on their faces as a mark of beauty, while the deeply religious, dignified, robe-clad bearded men, of sturdy physique and unusually large heads, might have stepped straight from the pages of the Bible.

In the 1870's, Japan, fearing Russian encroachment and aided by foreign experts including many American agriculturists, made a definite effort to colonize Hok-

An Ainu family at home, seated around the abeoi, *to the left above which is suspended the* suwate, *curious adjustable pothook. These white worshipers of the bear live and dress much as they did before they were driven north and finally conquered by the Japanese a thousand years ago.*

The hand loom of the Ainus is used to weave cloth made from the inner bark of the elm.

kaido. Since that time, the Ainus have lived in close contact with the Japanese settlers, yet neither race has been influenced to any degree by the other. In the matter of everyday dress, the Ainus have borrowed the cotton material of the Japanese, but the style of their garments remains as always, and on ceremonial occasions they continue to wear the *attush*, an Ainu robe made of material woven on hand looms from the inner bark of the elm and decorated with characteristic appliquéd geometric designs in a style worn a thousand years ago.

Despite the efforts of Christian and Buddhist missionaries and the recent banning of the bear festival, his only public religious manifestation, the Ainu clings doggedly to his own religion — the worship of the bear and numerous other gods. There are neither temples nor shrines in Ainu communities. Every man's home is his temple, containing a god shelf and a sacred east window, and on his hearth the goddess of fire is worshiped daily. The goddess of fire receives especial attention because, living in the reddest part of the fire on the hearth, she knows the intimate life of the family and will appear as a witness at the judgment day, a private hearing held directly after death. From her testimony there is no appeal.

The Ainus, like the Chinese, are a conservative race. In the early days no man dared even so much as to vary the shape of the roof of his modest grass home without consulting his neighbors. Today, Ainu houses are of a common design, varying in size only. Having learned the art of building before the advent of metals, the Ainus have found no reason for changing, and nails have no place in the construction of their houses. A true Ainu roof is constructed with a triangle of poles lashed together with fibers and placed at each end of a ridgepole without center supports. This form of roof, minus supports, is held by modern anthropologists to be proof that the Ainu house once consisted of a roof only, or perhaps a roof over a hole in the earth. They believe that the roof was at a later period raised and placed atop grass walls. This hypothesis would account for the mysterious pits found throughout Hokkaido, which have given rise to the theory that the early aborigines were pit dwellers.

The construction of the Ainu house is a simple process. The framework of the roof is first lashed together, then lifted atop posts and thatched in bristly layers with *kaya*, a native pampas grass. An opening is left in each gable as a smoke exit. The same *kaya* grass is rolled into thick bundles a dozen inches in diameter and six or seven feet long. These are placed on end and woven together to form the walls. Woven reeds cover the floor, which is usually dirt. Many modern houses are partly floored with planks. The usual design is one large room which is used as a place for living, sleeping, cooking, and worship, and a small anteroom which serves as an entrance way and as a storage place for water jars and the cooking pot. The more affluent the family, the larger the main room. A chief's house which I occupied in Siraoi was perhaps 50 by 40 feet. The main room was completely floored, while the anteroom had the usual hard dirt floor. Even in the double-crossing Twentieth Century, the Ainus, an essentially honest folk, have found no use for locks and keys. A thatched storehouse on stilts, a bear pen, also on stilts, and a sacred hedge composed of poles planted in the earth before the east window and adorned with fetishes and bear skulls, complete a typical Ainu establishment, which is usually set in the middle of an acre plot of vegetable garden. In a climate of Siberian intensity, the universal heating system is a simple box, two by three feet, filled with ashes and imbedded in the floor, in which a wood fire blazes. This hearth, called *abeoi*, is used for cooking and makes little pretense of supplying heat to warm the spacious and lofty room. Although smoke is supposed to exit via smoke holes in the gables, smoke-filled houses have undoubtedly contributed to the poor eyesight of the Ainus. Above the *abeoi* hangs the *suwate*, a cleverly devised adjustable wooden pothook, crudely decorated with carvings. Japanese, although using the *abeoi* style of hearth, do not customarily make use of a pothook. On Hokkaido, I noted with interest that the adjustable pothook was the one custom which the settlers had borrowed from the Ainus.

In early days a separate house was built for an aged person. At his death this was immediately burned to prevent evil spirits from finding their way back among

Ainu women at work before a grass house pound millet into flour. The geometrical figures on their costumes are characteristic.

Tekate, an Ainu centenarian, continues her weaving though she is totally blind.

An Ainu boy makes his own snowshoes on Hokkaido, where they are a winter necessity.

the living. I encountered many old women living alone awaiting a visit from the angel of death. When a member of a family succumbs, and destroying the dwelling is economically impracticable, the possible return of evil spirits is thwarted by having the corpse removed through a hole torn in the grass wall. This is repaired while burial is taking place. Thus are evil spirits confused and unable to find their way into the home. When leaving the cemetery, the mourners, including the women with their faces covered with white veils, walk backward until they come to a bend in the road, so that evil spirits may not cling to their backs. The grave marker, a post shaped like a halberd, is set up at the time of burial, not so much in memory of the dead as a warning to the living to avoid the place.

The Ainu has a lot of "savvy" and has survived because he is quick to adapt his environment to his needs. Living in a land devoid of clay suitable for pottery, he devised containers by cleverly folding wide strips of bark. Since these are not fireproof, he managed boiling by dropping heated rocks into water in the pots. From local hardwood he carved platters, bowls, and wooden spoons necessary for daily use.

The reindeerskin parka and moccasins of an old-time Ainu are of the same design as those worn by the present-day Laplander. When deerskin became scarce, the Ainu fashioned his moccasins from salmonskin, using coarse grass to stuff them, a custom in vogue in Lapland today. The Ainu, like the Hawaiian, utilized the feathers of birds in making garments. The aborigine in the Arctic fashioned his shirt for warmth, using the skins of birds with the feathers left on, while the South Sea Islander used the feathers to make a gorgeous cape for ceremonial occasions.

The design of the small wooden hand loom used in weaving has not changed since it was invented, and a characteristic sight in any Ainu community today is that of a tattooed woman, seated on a mat in the sunshine in the yard with the loom fastened about her waist and the opposite end of the woof attached to a corner of the house some seven yards distant, weaving garments for her family from the prepared bark of the elm tree. Four days are required to weave sufficient material for an *attush*, but two such garments, when supplemented with alien cotton material for everyday wear, will last a man a lifetime. Mats are woven on the crudest of looms, composed of two forked sticks stuck in the earth with a cross pole between them. A couple of dozen peanut-shaped smooth stones tied to the woof are tossed back and forth over strips of bark placed along the cross pole during the weaving, a job frequently performed by elderly blind women. Despite their crudeness, such sticks are priceless to the Ainu and are preserved from generation to generation. I saw one such loom which had been in the family for more than 100 years.

A forked stick also serves as a bobbin on which bands woven from linden bark are wound. These will be used as lacings for burial mats, or attached to a woven headband for carrying the baby. I interrupted Tekate, a totally blind 100-year-old Ainu woman, seated on a mat near the firebox in her home busily twisting bark into useful rope and winding the finished product on a forked stick. She consented to be photographed, but first she had to dress for the picture. She hobbled to a dark corner, found her death chest, and brought it to the door. Within the chest I saw a tin hot-water bottle, burial lacings, beads, and trinkets. I gasped at the bright colors in her *attush*. Dressed in her best, Tekate did not appear so mummified as one might expect. Her hands, wrists, and forearms were tattooed in an elaborate pattern, and the mustache around her mouth showed a strong blue after 90 years of wear. Her shoulder-length shock of hair, bound with a black bandeau, was far from gray.

The Ainus possess the secret of making an extremely potent poison. It is concocted by a few elders of the village, and the manufacture of (*Continued on page 324*)

The Economics of Innovation

Two Stages Are Involved in Adjustment of the National Economy to New Products

By Ralph E. Freeman

FROM behind the closed doors of research laboratories we hear whispers of discoveries which, when applied to peacetime uses, will radically change our way of living. But one does not have to put one's ear to the door of the laboratory to become aware of this fact. The press and the radio are predicting revolutionary technical developments based on the new materials, techniques, and sources of power that wartime scientific research will bequeath to a postwar world.

At a convention of the American Chemical Society, Charles M. A. Stine gave impressive testimony as to the promise of further progress: Already, under the pressure of war, "our world of 1940 . . . has become an antiquity," he said. "The inconceivables of two years ago are to-day's realities. . . . The pressures of this war are compressing into the space of months developments that might have taken us a half century to realize if necessity had not forced the pace." In the course of his address, Dr. Stine had something to say about economic problems. These developments, he predicted, will raise the level of living to new heights. He made a plea for freedom of economic enterprise as a means of encouraging producers to take risks and to exercise initiative in the application of scientific discoveries to human use.

The fate of the system of private enterprise rests largely upon its ability to function without periodical breakdowns that entail staggering loss of output and widespread unemployment. Though experience demonstrates the long-run economic blessings of scientific advance, it also suggests that the short-run influences may not be entirely beneficent. Indeed it is conceivable that the compression of a century of technological progress into a few months or years will have a disconcerting effect upon our industrial life. The attempt to develop and apply such a gigantic accumulation of innovations might be so far beyond the adaptive capacity of the economic system as to generate a great inflationary boom with a following deflationary collapse.

The economic process of innovation may be divided into two phases: The first is the tooling-up period, during which the new industries provide themselves with plant and equipment. The second is devoted largely to utilization of the productive instruments to turn out finished goods for consumers. There is a limit to the capacity which any industry can profitably utilize at any one time. As this limit is approached, new construction tapers off and the provision of consumers' goods becomes the dominant activity. If only a single industry is involved, the shift from the first to the second phase may proceed with little disturbance. If many industries are affected simultaneously, however, the shift may be fraught with the possibility of serious maladjustment, and the first period is likely to be one of upswing to prosperity, with the second a downswing to depression.

UNDOUBTEDLY much plant and equipment will be ready for the innovators as soon as the war is over. According to Dr. Stine, "The nation will emerge from this war with capacities for making plastics, synthetic fibers, nitrates, hydrocarbons, high octane gasolines and literally scores of chemicals and other raw materials on a scale that only two years ago was beyond our comprehension." Moreover, many factories now making planes, tanks, guns, ammunition, and other implements of war are convertible to civilian production without large expenditures for capital goods. In fact, we may anticipate finding ourselves with ample, perhaps an excess, capacity to produce some kinds of equipment, such as machine tools. In so far as the necessary means of production are already in existence, the economic stimulus of postwar technological development will be reduced.

But if the scientific discoveries are as numerous and important as has been forecast, our requirements for investment goods will far exceed the amount which will be available to us as the result of wartime expansion. The new materials must be converted into new commodities — a process which will call for billions of dollars of new equipment. In design, structure, and location, many existing factory buildings will be unsuited to the production requirements of the future. If the automobile industry's slate has been swept clear for a fresh start and if housing is to be revolutionized by new structural and insulating materials as well as by new methods of lighting and air conditioning, more producers' goods will be required. If "the newest and most versatile of plastics will be available after this war on a scale beyond all previous conceptions," a vast amount of new equipment will be needed to fabricate them into finished goods. And the economic effect of war research is sure to be felt in established industries. As old materials and techniques become obsolete, the demands for new capital goods in existing industries will increase. The railroads, for example, are said to be planning a large-scale utilization of recent technical improvements. Thus the wave of scientific progress may carry the whole industrial system into a greatly enlarged volume of investment expenditure.

The basis for an inflationary boom may be described in terms of the fundamental economic tendency for the money value of goods produced and offered for sale to move into equality with the money income being offered to buy these goods. When the former is in excess

of the latter, competition among sellers forces down the prices of the goods, thus reducing their total money value. When the income offered for goods is in excess of the money value of the goods, competition among buyers raises prices, thus increasing the value of goods. Though this process may be described as a movement toward equality, or equilibrium, its outcome may be good or bad depending on how the economic system is managed.

Consider the condition of the system at the present moment. The money income being paid out by manufacturers engaged in war production is becoming larger, while the physical volume of goods available for purchase by civilians is becoming smaller. Under these conditions, prices have a strong tendency to rise, thus bringing the value of civilian production into equality with the growing volume of monetary purchasing power. These equilibrating forces exert an inflationary pressure. The remedy, of course, is to establish equilibrium by some means other than that of price advances. Since restoration of the equilibrium by an increase in the amount of civilian goods is out of the question, the only alternative is to curtail the money income flowing into the market. As we all know, gigantic efforts are now being made to accomplish this result through higher taxes and larger civilian purchasing of government bonds.

The exploitation of technological innovations after the war will present a similar problem. The money to finance investment goods will have to come from savings, supplemented if necessary by bank credit. "Savings" may be defined as disposable income minus consumption expenditure; "investment" may be defined as the actual expenditures on investment (durable) goods.* Whether the volume of savings will be sufficient depends chiefly upon the magnitude of the new investment opportunities that will be opened up. If investment undergoes a substantial increase, there is no reason to suppose that savings will keep step. The two processes are different, are conducted largely by different groups of people, and are subject to different motivation. Our war experience gives evidence of this fact. In spite of gigantic efforts to induce people to curtail consumption and save more, the volume of war production now outruns by astronomical amounts the sales of government bonds to the public.

Probably, therefore, investment will tend from time to time to exceed savings, thus creating gaps to be filled by expansion of credit by the banks. As inequalities appear between spendable income and goods for sale, inflationary pressures will be generated. Prices will be driven upward, not because of government spending financed by the sale of bonds to the banks, as at present, but because of private investment financed by the expansion of bank lending to business enterprises.

To enlarge upon the economic consequences of inflation is perhaps unnecessary. Rising prices increase the expectation of profit. Modern business is conducted through the purchase and sale of goods and services. Since purchases usually precede sales, upward price swings permit the businessman to buy cheap and sell dear, and since wages, interest rates, and the prices of other cost elements generally rise more slowly than the prices of goods produced, the result is a widening profit margin. Profit is the actuating force in business. When there is expectation of increased profit, production schedules are enlarged, employment expands, and the national income increases.

THERE is, of course, a vast difference between the production of instruments for war and the production of an industrial apparatus which will in due time be capable of furnishing new commodities and services for consumers. When that time comes after the war, the economic system will enter the second stage of the process of innovation. As additional finished goods appear, absorbing more and more of the purchasing power of the community, the rate of production of plant and equipment will diminish. A shift from the making of instruments of production to the making of finished goods will occur. As already suggested, at some stage in the development of an industry a transition from adolescence to maturity takes place, and a redistribution of productive agencies results. If this transition occurs at different times in different industries, the task of readjustment will be less disturbing than if it occurs simultaneously in many industries.

One might suppose that the economic system would adapt itself to this shift of production, that some of the capital and labor formerly engaged in producing investment goods would be taken over by enterprises producing the new consumers' goods. In this way a collapse in one of the segments of the economy would be counterbalanced by expansion in another without any net diminution in employment and income. Unfortunately, however, a perfect mobility of resources does not exist. The transfer of capital which is embodied in buildings, machinery, and other fixed forms can take place only as the fixed capital wears out. Impeding the movement of workers are many obstacles, such as lack of training, transportation difficulties, and ignorance of the labor market. Meanwhile idleness of plant and unemployment of labor cut down the amount of money income paid out in the capital goods industries, and the resultant curtailment of purchasing power will have serious repercussions throughout the whole economy.

Yet even if the adaptive capacity of the system is able to take care of the readjustments involved in these changes, trouble is likely to arise in this phase because of a deficiency in money income. Here the question of savings crops up again. The amount saved, as already explained, does not vary with changes in the need for savings. Savings are used to buy production equipment and other durable goods. What is likely to happen when expenditures for these goods decline? Two changes will probably occur: First, the additional bank credit that was injected into the system to finance the expansion of durable goods will gradually be withdrawn and, second, some of the community's savings will from time to time be uninvested, or hoarded.

The first of these results will tend to bring to a stop the price rise that had been fostered by the additional credit which the banks had been creating. Less money will be available to spend. In (*Continued on page 330*)

* These definitions are essentially those adopted by D. H. Robertson, whose "period analysis" may be regarded as the basis of the above discussion.

Four on War

From the Writings of Earlier Scientists Is Culled Proof of Their Efforts for Life Rather Than Destruction

By M. F. Ashley Montagu

THE war in which we are now engaged is beyond all others one in which science and technology will play a decisive role. Scientists in the so-called pure and applied sciences are today, as never before, doing their utmost to create and improve the mechanical devices and other processes which will serve to bring about the utter rout and defeat of our enemies. The sooner this is done, the better. This is the sentiment which scientists, possibly more than any other group of men, feel deeply. They will increase the expenditure of their energies to the limit the sooner to bring this conflict to a victorious conclusion. Scientists are interested in life, in the continuing and increasing good of the greatest number; they are distinctly *not* interested in death or in the use of their creative powers to destroy. So have they always felt, but when their homelands have been threatened by foreign tyrants, they have always been among the first to come to their countries' defense.

As illustrative of the long tradition of this social consciousness in peace and war, several little-known statements, which are in themselves of the greatest interest, from the writings of four great scientists will be cited here. Of these scientists, the first, Leonardo da Vinci of Florence (1452–1519) was a great artist, anatomist, and engineer; the second, Nicolò Tartaglia of Brescia (circa 1506–1559), was a great mathematician and the founder of the science of ballistics; the third, Father Francesco Lana (1631–1687), was the inventor of the first airship; and the fourth was our own Benjamin Franklin (1706–1790).

Leonardo, who had been military engineer in the Romagna under Cesare Borgia, stigmatized war as "the most bestial madness," but he added this significant qualifying remark: "When besieged by ambitious tyrants I find a means of offence and defence in order to preserve the chief gift of nature, which is liberty. . . ."[1] Though written more than 400 years ago, these words may still serve scientists as an inspiration and motto. Among the instruments of offense and defense in war designed by Leonardo, drawings or descriptions of which have been preserved, are the three great weapons of modern warfare — the bombing airplane, the tank, and the submarine. In the account of the latter, written during peacetime about the year 1500, Leonardo expresses himself on the caution with which it is necessary to describe inventions that may be put to barbaric uses by unscrupulous men. This passage is to be found in his notes on "The Nature of Water" and reads as follows:

"How by an appliance many are able to remain for some time under water. How and why I do not describe my method of remaining under water for as long a time as I can remain without food; and this I do not publish or divulge on account of the evil nature of men who would practice assassinations at the bottom of the seas by breaking the ships in their lowest parts and sinking them together with the crews who are in them; and although I will furnish particulars of others they are such as are not dangerous, for above the surface of the water emerges the mouth of the tube by which they draw in breath, supported upon wine-skins or pieces of cork."[2]

It was for good, not for evil, purposes that Leonardo wished his inventions to be used, but when the people with whom he had identified himself were besieged by ambitious tyrants, he freely offered his inventions in order to preserve the chief gift of nature, which is liberty. In similar case was Nicolò Tartaglia. In the "Epistola"

[1] Edward McCurdy, *The Notebooks of Leonardo da Vinci*, II: 210.

[2] *Ibid.*, p. 109

Left: *Leonardo da Vinci, an engraving by Morghem from a self-portrait;* right: *Nicolò Tartaglia*

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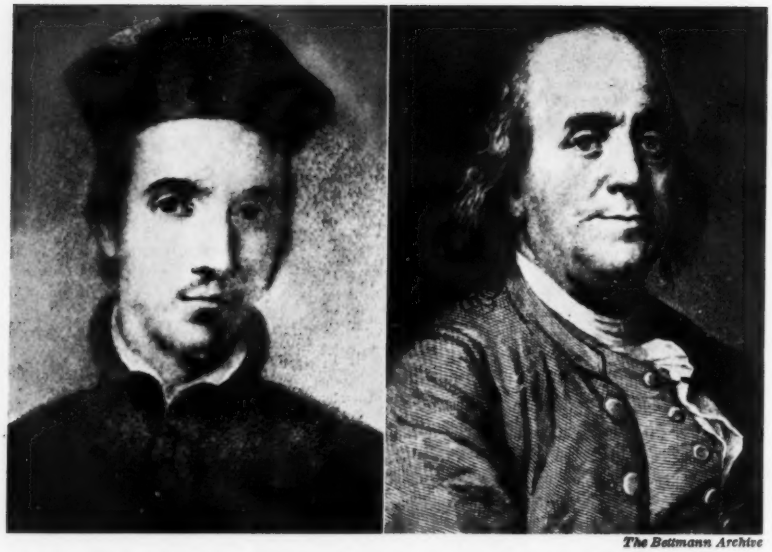

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Left: *Father Francesco Lana, from a drawing preserved in the College of the Societas Jesu in Brescia;* right: *Benjamin Franklin, a steel engraving after the portrait by Duplessis*

to his *Della nova scienza*, written at Venice on the 20th December, 1537 (Old Style), and addressed to His Excellency the Duke of Urbino, Tartaglia writes: "When I was living in the town of Verona, Illustrious Duke, one of my intimates, my cordial friend, the master of ordnance at the old castle, a man of experience and great skill in his art and endowed with an abundance of good qualities, asked me one day my opinion how to aim a piece of artillery to give it the greatest range. Although I had no practical knowledge whatever of artillery, for in truth, Excellent Duke, I have never in my life shot a single round with firearms, arquebus, bombard, or musket, nevertheless, being desirous of serving my friend, I promised shortly to give him a definite answer to his question."

Tartaglia then proceeds to give an account of his attack upon the problem set him by his friend and goes on to remark: "As the result of this I had the intention of writing a treatise on the art of artillery, and to bring it to a degree of perfection capable of directing fire in all circumstances, assisted only by a few particular experiments. For as Aristotle says in the seventh book of the *Physica*, Section 20, 'particular experiments are the basis of universal science.'

"But, since then, one day meditating to myself, it had seemed to me that it was a thing blameworthy, shameful and barbarous, worthy of severe punishment before God and man, to wish to bring to perfection an art damageable to one's neighbor and destructive to the human race, and especially to Christian men in the wars that they wage on one another. Consequently, not only did I altogether neglect the study of this matter and turned to others, but I even tore up and burnt everything which I had calculated and written on the subject, ashamed and full of remorse for the time I had spent on it, and well decided never to communicate in writing that which against my will had remained in my memory, either to please a friend or in teaching of these matters which are a grave sin and shipwreck to the soul."

In view, however, of preparations for the invasion of Italy by the Turks, who were instigated by his Most Christian Majesty the King of France, much as Hitler in our own time plays Mephistopheles to Japan's Faust, Tartaglia suffered a change of mind, and so he writes: "Today, however, in the sight of the ferocious wolf preparing to set on our flock, and of our pastors united for the common defense, it does not seem to me any longer proper to hold these things hid, and I have resolved to publish them partly in writing, and partly by word of mouth for the benefit of Christians, so that all should be in a better state either to attack the common enemy or to defend themselves against him. I regret very much at this moment having given up this work, for I am certain that had I persevered I would have found things of the greatest value, as I hope yet to find. . . . I hope that your Lordships will not disdain to receive this work of mine so as better to instruct the artillerymen of your most illustrious government in the theory of their art, and to render them more apt in practice."

As far as I have been able to discover, this represents the first published statement of its kind made by a scientist. Leonardo's remarks in connection with his submarine were not published until almost four centuries after his death. Tartaglia admirably expresses the feelings of many scientists today.

Perhaps one of the most remarkable previsions of the diabolical uses to which aircraft would be put by men was uttered by Father Francesco Lana, an Italian Jesuit monk who, in his book *Prodromo* published in 1670, described in considerable detail an airship which would be moved through the air by paddles. After enumerating the six technical objections that he foresaw to his invention, which owing to his poverty he was unable actually to construct, he goes on to say: "Other difficulties I see not, which may be objected against this invention, besides one which to me seems greater than all the rest, and that is, that it may be thought that God will never suffer this invention to take effect because of the many consequences which may disturb the civil government of men. For who sees not that no city can be secure against attack, since our ship may at any time be placed directly over it, and descending down may discharge soldiers; the same would happen to private houses and ships on the sea. For our ship descending out of the air to the sails of sea-ships, it may cut their ropes, yea without descending by casting grapples it may overset them, kill their men, burn their ships by artificial fireworks and fireballs. And this they may do not only to ships but to great buildings, castles, cities, with such security that they which cast these things down from a height out of gunshot cannot on the other side be offended by those below." (*Continued on page 334*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

M.I.T. Photo

Henry E. Rossell, '15

To Build Ships

HENRY E. ROSSELL, '15, Professor of Naval Construction at the Institute, has been elected president and general manager of the Cramp Shipbuilding Company in Philadelphia, and Garland Fulton, '17, who has been chief engineer since 1941, has been elected vice-president. Professor Rossell has been granted a leave of absence to accept his new post in one of the country's oldest and most famous shipbuilding companies. He succeeds Rear Admiral William G. DuBose, United States Navy (retired), who becomes chairman of the executive committee of the board of directors. Professor Rossell, who joined the staff of the Department of Naval Architecture and Marine Engineering in 1931, is a commander, and the new Vice-president is a captain, on the retired list of the United States Navy.

Having been engaged since 1940 in an advisory capacity on the rehabilitation and equipment of the Cramp shipyard, Professor Rossell is thoroughly familiar with the operations of the company. He also has made special studies of welding sequences in the construction of naval vessels and has been a consultant for maritime companies.

After a two-year tour of sea duty following his graduation from Annapolis in 1910, Professor Rossell did postgraduate work in naval construction at the Institute. From 1915 to 1920 he was on duty at the New York Navy Yard in various administrative capacities, and from 1921 to 1925 served at the Philadelphia Navy Yard, the greater part of the time as production superintendent. From 1927 to 1931 he was detailed as head of the department of mathematics at the United States Naval Academy. While department head there, he wrote a paper dealing with the development of welded bulkheads for ships, giving the results of research which he had directed while in the Bureau of Construction and Repair. The research gave a strong impetus to the widespread adoption of electric welding in the shipyards of the country. The Cramp yard, incidentally, was the first "all-electric" yard.

Professor Rossell is the author of a number of professional articles and was co-editor of *Principles of Naval Architecture*, a two-volume work recognized as an authority in its field. The publication was sponsored by the Society of Naval Architects and Marine Engineers. A member of the council of the Society of Naval Architects and Marine Engineers, Professor Rossell is also a member of the United States Naval Institute, the Institution of Naval Architects, London, and the Northeast Coast Institute of Engineers and Shipbuilders, Scotland.

Captain Fulton was graduated from the Naval Academy in 1912. Following two years of sea duty, he was selected for a postgraduate course in naval architecture and marine engineering at Technology. Upon completion of this course, he was transferred to the Construction Corps of the Navy and assigned to duty at the New York Navy Yard. Thereafter he held various engineering assignments in Washington and elsewhere.

Revision of Courses

AN administrative committee appointed to study revision of certain parts of the Institute's curriculum has recommended that the undergraduate Course in Public Health Engineering and the undergraduate Course XI, Sanitary Engineering, be discontinued and that undergraduate studies in sanitary engineering be offered as group electives leading to the degree of bachelor of science in Civil Engineering. The committee also recommended that a graduate program leading to the degree of master of science in either Sanitary Engineering or Public Health Engineering be continued under the direction of the Department of Civil and Sanitary Engineering.

This revision of Courses follows the suggestion of the Visiting Committee of the Department of Biology and Public Health, which had earlier recommended that the awarding of degrees in Public Health be discontinued and that a study of other Courses be made to consider the possibility of consolidation or revision to prevent duplication.

The undergraduate Course XI, Sanitary Engineering, will be discontinued after February, 1944, permitting students at present enrolled in it to complete their program. The new program in the Department of Civil and Sanitary Engineering will start in June and will be open to students who have completed the sophomore year in Civil Engineering.

Reports and Hobbies

MEETING in Walker for the last time for the duration, the Alumni Council, at its 230th session on the first Monday in March, heard numerous reports of officers and committees and had as speaker of the evening Arthur C. Watson, chairman of the Committee on the Technology Museum, who described the varied activities of the M.I.T. Hobby Shop, which has developed under his guidance. In the absence of Francis A. Barrett, '24, President of the Alumni Association, the meeting was conducted by Harold Bugbee, '20, Vice-president.

Business included a survey of the very successful Alumni Day 1943 by Herbert R. Stewart, '24, chairman of the banquet committee, reporting for D. Walter Kendall, '24, chairman of Alumni Day 1943. In his regular report, Charles E Locke, '96, Alumni Secretary, explained changes in the bylaws necessary to adjust dates to permit the combining of ballot and Alumni Fund mailings, and presented the annual election slate summarized in The Review for March. A description of the growth of the Alumni Fund over the past three years was made by Henry B. Kane, '24, Director of the Fund.

Sketching the origins of the Hobby Shop in freshman hobby shows held at Open House in 1936 and 1935, and in an earlier survey of the avocations of freshmen, Mr. Watson described the beginning program out of which the present organization has grown, its early stages being guided by Vannevar Bush, '16, then Vice-president of the Institute. Management of the shop was placed in the hands of the Museum Committee, Mr. Watson said, but from the beginning many staff members throughout the Institute have warmly co-operated. Policy has been to allow the students maximum freedom in the running of the shop. The machines were set up originally by a group of students, who built benches and tool racks and generally took the responsibility for seeing things get started. Later the group organized to perpetuate the tradition, made rules for safety, arranged lectures and exhibits, published their own newspaper, and otherwise kept up a co-operative spirit.

The shop is also used for the building of Museum exhibits, and many students have felt privileged to use their ingenuity in contributing to some of the best displays now seen in the corridors of the Institute. Not only technical problems but human problems as well are worked out in the shop, Mr. Watson explained. He showed a number of slides to give a better idea of the shop, its equipment, and its operations. Raymond P. Mork, '43, and Benjamin F. Pugh, '45, assisted Mr. Watson in his presentation, which evoked not only interested questions but also the offer of various materials and equipment for furthering the hobby program.

Women in Engineering

ALTHOUGH women have been quick to accept the opportunities opened to them by the insistent demand for labor in war industry, few of those whose educational background equips them for intensive training for technical positions realize that the engineering professions have also made available posts which a few years ago were closed to women. Prejudice against women in engineering, born perhaps in the vanity of man, is rapidly disappearing, and the contributions of the young women who have been quick to realize their potentialities have astonished industry.

Latest reports indicate that approximately 40 per cent of the workers in England's industries are women and, in addition, thousands of girls occupy technical positions of professional rank which are of critical importance to the progress of the war program. Women with college degrees in science, engineering, or economics

Désiré Despradelle, 1862–1912, Rotch Professor of Architecture from 1893 to 1912, was memorialized by students who presented this bust of him to the Institute. In the Rogers Building it has lately been given a new and appropriate setting designed by Harry W. Gardner, '94, Professor of Architectural Design. Some of Despradelle's interesting projets are hung near by.

M.I.T. Photo

have the requisite qualifications for further intensive training, preparing them to play an important part in the nation's war effort. In some engineering fields, high-school or junior-college certificates fulfill the requirements for special training programs.

Most of the courses now being given at the Institute under the sponsorship of the Engineering Science and Management War Training Program are open to women, and in every instance successful completion of a course has led to immediate employment in responsible, well-paying positions. All the young women trained at the Institute in the aeronautical engineering course last year are making important contributions in professional engineering positions in the aircraft industry. Many more could have been placed.

Recently the Institute started a 16-week course in naval architecture and marine engineering to qualify women for positions as junior naval architects under Civil Service in shipyards throughout the country. Meteorology is another field in which women can find excellent opportunities, not only during the war emergency but when peace returns. Other fields which are of special interest to women in the war emergency are chemistry, engineering drawing, industrial management, map drafting and interpretation, mathematics, radio communication, motor traffic management, optical instruments, applied physics, planning and scheduling, production control, purchasing methods and procurement, structural analysis, contracts, priorities and allocations, and work simplification.

Charles T. Main, 1856–1943

CHARLES T. MAIN, '76, distinguished engineer and a life member of the Institute's Corporation, died on March 6. He was 87 years old and until recently had been active in the affairs of the engineering firm which bears his name.

After his graduation from the Institute, he served for a year as an assistant on the staff of the Department of Mechanical Engineering, from which he withdrew to begin an engineering career that was closely associated with the development of New England's great textile mills in Manchester, N. H., and Lawrence, Mass. He became an authority on construction of both steam- and water-power developments for textile plants, and he was widely consulted in this field. In 1893, Mr. Main joined with F. W. Dean to form the firm of Dean and Main, after the dissolution of which in 1907 Mr. Main established the firm of Charles T. Main. He held the important post of consulting engineer for the construction division of the United States Army in the first World War, and he was one of a number of leading American engineers who went to France as members of the American technical delegation that assisted the French Government in the vast task of rehabilitation.

As an alumnus of the Institute, Mr. Main showed a lifelong interest in the activities of Technology. For years he had served as secretary of his Class, and he was president of the Alumni Association in 1901. Having been a term member of the Corporation for 10 years, he was in 1918 elected a life member and served on the Executive Committee for many years.

Charles T. Main, '76

Mr. Main was a fellow and past president of the American Society of Mechanical Engineers and a holder of its 50-year button. He was also a former president of the Boston Society of Civil Engineers, was awarded its Desmond Fitzgerald Medal in 1914, and was made an honorary member in 1932. At one time he was president of the American Institute of Consulting Engineers, and he had been a member of the Newcomen Society and the American Academy of Arts and Sciences. Northeastern University awarded him the honorary degree of doctor of engineering in 1935.

In 1883, Mr. Main married Elizabeth F. Appleton of Somerville. Of their three children, two survive — Theodore Main, '16, and Alice Appleton Main. Mr. Main's older son, Charles R. Main, '09, who shared his father's constant interest in the Institute — having been secretary of the Class of 1909 and a term member of the Corporation — died last August 22.

Director of Research

MANUEL S. VALLARTA, '21, Professor of Physics and internationally known for his investigations of cosmic radiation, has been granted a leave of absence to serve as executive chairman of the Mexican Council for the Promotion and Coordination of Scientific Research. This position, to which Dr. Vallarta was recently appointed by Avila Camacho, President of Mexico, corresponds to the post held by Vannevar Bush, '16, director of the Office of Scientific Research and Development in Washington.

Dr. Vallarta is a fellow of the American Physical Society and the American Academy of Arts and Sciences.

RESEARCH AND PATENTS

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is open to newcomers who can contribute substantial patent assets, it is an altogether healthy thing. Certainly it is an efficient method of getting new developments into prompt production without awaiting the result of lengthy litigation.

OF course our patent laws from time to time need revision to meet changing conditions and avoid possible abuses. Such revision is done when necessary; the commissioner of patents suggested not long ago a number of administrative changes, which had general approval of those closely concerned with patents. Most of them have already been adopted. This discussion is concerned rather with more drastic suggestions which have been urged by various individuals and which have not received such general support.

The present system of licensing under patents is the first target that comes under heavy fire in these suggestions. Various types of provisions for compulsory licensing are vehemently advocated by some critics of our system. Others argue with equal stridency for the prohibition of restrictions in licenses.

The argument generally used in favor of compulsory licensing is that many patents are used to suppress inventions. If that were true, there would admittedly be argument for some form of compulsory licensing, but to the best of my knowledge none of the extensive hearings on patent matters has dug up a single authentic case of this kind. In all my experience dealing with patents and inventors or trying to get licenses, I have never found a patent owner who took that attitude. Frank B. Jewett, '03, whose experience in this field is unexcelled, wrote not long ago:

> Despite the fact that I have made diligent inquiry over the years I have never been able to locate a suppressed patent nor have I ever found any one who could cite an authentic case of suppression. . . . The plain truth of the matter is that a large part of unused patents are worthless things which the inventors insisted on patenting and on which the Patent Office had to issue patents because the ideas presented were technically new and novel — the Patent Office does not pass judgment on the utility of the patents it grants. They are not and never were anything anybody would use, in the face of better things, even if you gave the patents to him.
>
> Then there is the great group of unused patents which, although they may have had original merit, were rendered obsolete by subsequent inventions. Except for patents on really fundamental new ideas every new patent tends to kill the value of those which preceded it. . . . The only possible way for a business at all dependent on live patents to avoid extermination in the competitive struggle is to keep eternally at the process of replacing its dead and dying patents by new and better ones, and that mainly by its own creative effort.

Recent headlines about the suppression of patents on devices needed for war are nothing more than imagination, because legislation dating from the last War provides in effect for compulsory licensing of any patent needed by the government in time of war. Accordingly the whole matter should be dissociated from the war and regarded calmly from a long-range point of view.

The greatest objection to compulsory licensing in normal times is that it largely cancels the very reward the inventor was supposed to receive. It also interferes with the incentive of the patent owner or licensee to make a large investment in a new development, because he is confronted with the possibility that he may at any time be forced to give a competitor a license on terms which are unpredictable. If some way existed whereby one could properly determine a fair royalty and other reasonable terms in the event of compulsory licensing, much of the objection to it would be overcome. Inventions are so widely different in character and in the investment required to develop them, however, that it is impossible to set up any general standards as to the proper terms for a license. The old American art of horse trading between the patent owner and the man who wants a license is often time consuming and annoying, but it is probably the best way to arrive at the fair value of a license, and it has the further advantage of generally being open to readjustment as conditions change.

The proposal is sometimes made that the value of the compulsory license be arbitrated. While the principle of arbitration appeals to everyone as reasonable, the intangible factors make arbitration peculiarly difficult in the granting of a patent license: Both the terms and the royalty rate are open to so much trading back and forth, with past licenses under other patents often constituting part of the consideration, that a decision is even harder to reach than in the case I previously mentioned of determining the value of a single patent. Furthermore, the patent owner is at a peculiar disadvantage in such an arbitration in that he would be compelled to grant a license on the terms set by the arbitration, whereas if the prospective licensee who requested the arbitration did not like the terms, he could always find some reason for not going ahead with substantial use of the patent. Arbitration in such a case, therefore, is really one-sided, binding only on the patent owner.

Compulsory licensing would militate most seriously against individuals and small companies that would have to go outside to secure financing to further and exploit their patented developments. Venture capital cannot be attracted into new and hazardous fields without the prospect of unusual returns, which compulsory licensing would prevent.

While the granting of a patent monopoly seems virtually essential to afford an adequate incentive for research and invention, which every year become more expensive and difficult, yet once the invention has been disclosed and the patent granted, it is thereafter in the public's interest, and usually in the inventor's interest, to have licenses granted to as many people as can make effective use of the invention. Any license, however restricted, is in essence a voluntary concession of part of the owner's rights under his original patent monopoly. In disposing of part of his monopoly, the patent owner naturally must make clear just what he is giving away and what he is retaining for himself. Limitations in licenses, however, have recently been under heavy attack as though they were fundamentally undesirable, and legislation forbidding almost any such limitations has been proposed.

(*Continued on page 322*)

30,000,000 motorists will hold their breath

WE Americans might now be staring grimly at defeat if we had not thrust our industrial economy ten years forward over night. To do it we have drastically cut our own standard of living.

When it is over, when gasoline, tires, and the leisure to use them, are once again available, 30,000,000 motorists will hold their breath. Will look to Detroit for cars wrought of plastics and light alloys, cars that can whisper the miles away on a few cupfuls of fuel. For Americans picture an all-out peace when they finish a total war.

Never has an industry been able to feel surer of its market. And never have manufacturing problems appeared so complex. Innumerable materials will be available. Which should be employed for what? How can it be used to speed production, to better performance, to prolong service, to quicken sales?

For impartial answers, industry can bring questions about metals to Revere. For just as industry in the future will not be restricted to the traditional materials, neither will Revere. In addition to widening still further the uses for copper and its alloys, Revere has developed facilities for the manufacture of the light metals since the start of the war, and is pioneering in the production of wholly new alloys with important properties that can cut manufacturing costs for many industries.

Today the copper industry is producing only for victory. Copper is not available for anything else. But post-war planners with specific problems in metals are referred directly to the Revere Executive Offices in New York.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York

RESEARCH AND PATENTS

(*Continued from page 320*)

Actually, the net effect of drastic provisions against restrictions in licenses is likely to be the opposite of that intended. The practical aspect of this statement can possibly be best illustrated by another reference to the analogy of the ownership of land. Suppose a man is asked to grant a right of way for a road across a tract of land which he owns. He would probably be quite willing to grant such a right of way provided he received reasonable compensation and could protect his own rights in the remainder of the land by providing that the man who acquired the right of way must keep a certain distance from the landowner's house, construct and maintain fences, and agree not to trespass on the remainder of the land. These provisions are restrictive as to the rights and the duties of the man who acquires the right of way, but the important thing is that the latter does not lose any rights he ever had; he simply agrees to definite limitations on the new rights which he acquires. Now if a law is passed saying that all grants of rights of way must be unrestricted and without any limitation, the landowner will certainly be much less willing to grant rights of way; or if he does grant them, he will charge much more. Exactly these considerations apply to many of the proposed prohibitions against restrictions in licenses. It should be made as easy as possible for a man to chip away his monopoly gradually, however small the individual pieces.

One set of proposals, put forward last spring in Senate Bill 2491, would specifically outlaw any restrictions as to (1) price, (2) quantity permitted to be manufactured, (3) geographical limitations, and (4) use to be made of patents.

The modern trend in licensing, at least in the industries with which I am most familiar, is away from all restrictions on the price or quantity of patented articles to be produced under a license. Hence I cannot argue strongly against the prohibition of such restrictions. Even such prohibitions, however, would tend to discourage licensing or force up royalty rates in certain instances where a patent owner feels that such restrictions on first sale are necessary for his self-preservation.

The matter of prohibiting geographical restrictions is much more serious. For example, take a man in the East or Middle West who is manufacturing an article on which the freight to the Pacific Coast is quite large. He might be approached by a Pacific Coast manufacturer who wanted a license, and since the patent owner could not readily fill this market himself, he would be glad to grant a license if it could be limited to manufacturing on the Pacific Coast. If, on the other hand, geographical restrictions were prohibited so that he could not grant a license without throwing open the whole world to his licensee, he would probably decide to give no license at all, and the Pacific Coast would continue to suffer from the lack of a convenient source of supply.

Even more unfortunate would be the practical effect of the proposed prohibition of any limitations on the use which a licensee might make of a patented process or apparatus. The suggestion entirely overlooks the way most licenses are desired and granted by the majority of companies operating in the process industries. Suppose the X oil company owns a patent on a process capable of being used to make products of high value such as 100-octane gasoline, as well as products of relatively low value such as kerosene. If Y company wanted to take a license on this process for the purpose of making kerosene, it would undoubtedly say that it could afford to pay but a small royalty under these conditions. The X company would probably agree, provided that Y company used the process only for making kerosene. If, however, Y company later wanted to use it for making 100-octane gasoline or some other product of high value, such a royalty would be unreasonably low. Since a fair royalty for every possible use to which the licensee might want to put the process could not be determined in advance, it would best suit the needs of both X and Y companies to set a royalty rate for the use or uses definitely contemplated and limit the license to such uses. If the X company were permitted to give only an unlimited license for unknown future uses, it might well decide not to grant any license at the low rates appropriate for the making of kerosene.

Furthermore, although the Y company would be primarily interested in getting a license on only one or two specific patents, it would undoubtedly want, and expect to get, drawings and designs for complete equipment to carry out the process. In the design of that equipment might be half a dozen minor patented devices which neither X nor Y might have in mind. If Y were well advised, it would insist that it have the right to use any of X's patents in carrying out the specific process, and X might well agree to this "throwing in" of all incidental patents, provided that the uses of them were limited to the process under discussion; on the other hand, it would certainly not throw in all of its patents for use in any process which might come along, merely for the payment of a small royalty based on a kerosene operation. The great bulk of the process licenses granted in our industry do not attempt to enumerate all the patents and applications which might be useful in a given process but give a blanket license under any of the patent owner's present or future patents for the defined process. Such broad licensing of all the licensor's patents for the desired use, which is certainly very much in the public interest, would be made impossible by the proposed type of restriction.

(*To be continued*)

MAIL RETURNS

(*Continued from page 298*)

ished populations desire and are able to buy — in general, machine-made articles duplicating as nearly as possible the hand-built utensils, tools, clothing, and so on, they are now in the habit of using.

The abolition of poverty — for the world is headed for no less a goal — is attainable through free gift only a little. It is attainable chiefly by the hiring of poor peoples at work they are best fitted to perform and by the sale to them of goods within their financial reach in order to give them a reason for working. I would hazard a guess that a firm realizing the coming trend and joining it, or anticipating it even before the war is won — wherever opportunity is to be found — will fare better financially than one which does not.

New York, N. Y.

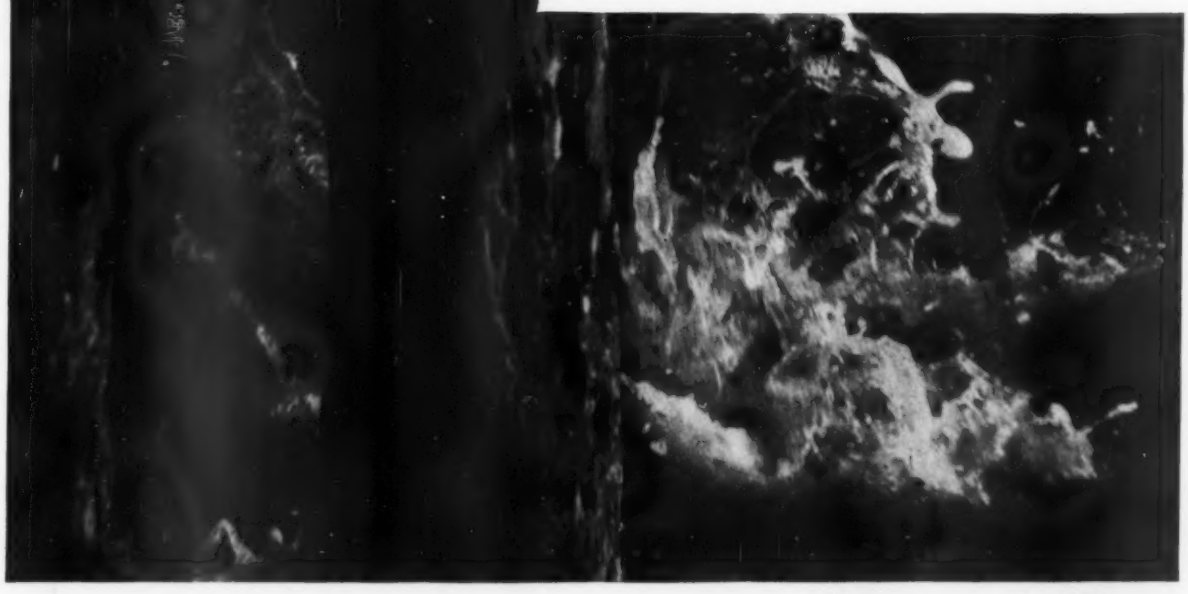
It happened barely two years ago — on January 21, 1941 — and already it is changing the shape of the world. On that night, men held in their hands a bar of the world's lightest metal — the first ingot of pure magnesium to be taken from the sea.

The men were chemists and engineers of Dow Chemical Company, and the metal mermaid which they held that night was the creature of many years of experiment in the field of ocean mining. As a result of those years of search and research, most of our production of over 200 million pounds of magnesium this year will come from the limitless sea, and plants are building for the production of many times that amount. . . . Also as a result of those years, a whole new age of light metal parts, products — and problems — has begun.

Today, 99 per cent of all magnesium production is going into aircraft. But after this war, with a wealth of experience, new techniques and a yawning capacity, magnesium will be ready to bid for other markets; streamliners, busses, trucks, trailers, engine forgings, household appliances, building materials, and the whole broadening field where weight and load factors are of increasing importance. And with this new production will come the problems.

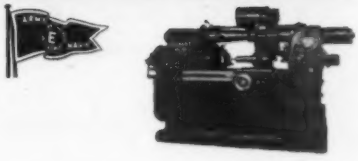
As specialists in internal grinding — with engineers and machines on nearly every aircraft production line in America — we at Bryant have had a great deal to do with parts made from lightweight metals.

We believe that this knowledge can be of greater value to you than ever before in meeting today's efficiency requirements and in planning ahead for tomorrow's. Bryant's Consulting Service is available to you at all times. Call upon us now!



Bryant Chucking Grinder Company

SPRINGFIELD, VERMONT, U. S. A.



We invite a forward-looking

MACHINERY MANUFACTURER or INVENTOR

to plan with us NOW for post-war expansion

War work has caused us to greatly increase our productive capacity. So when peace comes, we will have the equipment and trained personnel to manufacture not only our regular line of wrapping machines, but other types of machinery or devices. You may find it profitable to take part in our planning for such post-war expansion.

For 30 years we have been one of the leading makers of packaging machinery. Our machines are used by hundreds of concerns—in the food, drug, candy, tobacco, dairy fields, etc. Many of the advancements in mechanical wrapping now widely used were conceived by our Engineering and Designing Departmen..

For war, we have *designed and built* large groups of armament machines such as cartridge loaders, cartridge-clip loaders, machines to insert cartridges into cartons, linking machines for machine-gun bullets, etc.

We are now working on ideas to expand our regular line of wrapping machines and to add other lines of machines used by industries we do not now serve.

● You may have ideas for new machinery which need development. We will be glad to discuss them with you, and if mutually satisfactory, will develop them with you.

● You may have a machine or machines which you have been making in your own plant, but which might be improved and made with greater profit in ours.

Final arrangements may result in your coming into our Company—or may be worked out on some other desirable basis.

If you feel that you have something on which we might work together, we suggest that you communicate with us, giving full particulars. We can then arrange for a meeting.

PACKAGE MACHINERY COMPANY
Springfield, Massachusetts

ALONG THE ALEUTIAN ROUTE

(*Continued from page 312*)

it is a closely guarded secret. It is known, however, that they use the young roots of the *Aconitum japonicum*, a plant which grows in many sections of Hokkaido and is distinguished by its pretty purple blossoms. The roots, gathered in summer and dried in the shade, become soft. They are skinned, and the pulp is rubbed between two stones until a paste is formed. The addition of a little fox gall and the saying of proper prayers during preparation are supposed to render the poison particularly efficacious. A poison-maker fearlessly tests the strength of his concoction by placing a bit of it on the tip of his tongue. If right, it produces a peculiar sense of tingling, followed by numbness. When finished, the poison is placed in the sun to dry and thereafter is wrapped in a leaf with several fetishes, to be kept until needed. It maintains potency for about half a year. When required for use, the poison is again pounded and made soft. Sometimes a few mashed spiders and the poison from a scorpion are added. The poison is used to tip arrows used in hunting bear, deer, and large game. When the poison is to be applied, the arrowhead (generally made of bamboo) is hollowed out behind the tip. It is dipped into pine-tree gum, and then the poison is pressed into the depression with the thumb. This finished, the arrow is once more dipped into the gum, after which a leaf is tied around it for protection before it is placed in the quiver. In addition to hunting with the bow and arrow, the hunter sets traps along the trails frequented by wild animals. As the trap is touched off, a poisoned arrow is released, the mere prick of which is sufficient to kill an animal or man within 15 minutes. A stranger wandering in the woods is in greater danger from death by poison than from attack by the ferocious wild bears which roam the forests. When a hunter has been accidentally injured by a poisoned arrow, the only method he has to save his life is to cut a large hunk of flesh from the wounded part before the poison spreads. Hunters with courage enough to take this drastic measure frequently bleed to death.

Another interesting poison used by the Ainus especially in bird hunting, is made from the roots of a milkweed called *penup*. This root may be gathered either in the spring or in the fall after the leaves have been killed by frost, and it may be used in the fresh or dried state. Indeed, people hang it from the beams of their houses and use it in many ways. A few *penup* roots suspended over the doorway will serve to discourage the entrance of the evil spirits and ghosts which the Ainus believe to cause sickness. When there is illness in an Ainu home, the roots of the *penup* are chewed and sprayed by mouth throughout the house. In an epidemic, the inhabitants of the entire village engage in blowing *penup*. The uses for the root are many, and claims made for it sound like an advertisement for a patent medicine. It is efficacious as an antidote for food poisoning, stomache-ache, and smallpox. Men wear bits of the root as an amulet tied about their waists, while women hang it about their necks as a charm, incidentally ready for instant use. Eaten raw, *penup* has a not unpleasant, sweetish flavor

(*Continued on page 326*)

Under the Spreading Rubber Plants

When some day the wheels of the nation roll on tires made by the synthetic rubber plants now spreading across the country, it will be because automatic controls made the processes possible. And many of these controls will include Masoneilan equipment. Rubber plants already operating and others to come will depend on the accuracy, in-built quality and sturdiness of this equipment which has earned it a top spot in the esteem of the process industries.

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MASON-NEILAN REGULATOR CO.
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MASONEILAN

ALONG THE ALEUTIAN ROUTE

(*Continued from page 324*)

and, like marijuana, produces an intoxicating effect followed by faintness. Yet when thoroughly cooked, the roots are palatable.

Ainus find this poison especially effective in trapping the Bering Island raven, which flies down from Kamchatka to northern Hokkaido for the winter. The hunter prepares the bait by digging the flesh from a salmon, mixing it with *penup*, and restuffing the fish. He then puts the fish in places the raven frequents, and waits in ambush. After feasting on the poisoned salmon, the raven loses control of its wings and legs and flounders helplessly about like a drunken thing, easily captured. A crow may be brother to the raven, but he is made of tougher stuff. Having feasted on *penup* and salmon, he flies blithely away, unaffected, leaving a surprised hunter. The Ainus hunt the eagle in exactly the same interesting manner as do the people of the arctic Lofoten Islands. Ambushed near the place frequented by the eagle, the hunter snares its leg with a hooked wire. Unlike the Lofoten Islander, the Ainu saves himself the trouble of struggling with the angry eagle by quickly chewing *penup* and spitting it into the face of the king of birds. This has the effect of quieting it at once.

The aborigine used ingenuity in contriving his farming, hunting, and fishing implements. In the early days each family staked out a soft spot of earth, and from crooked sticks improvised farm implements with which to cultivate a few vegetables. To the Ainu women fell the lot of caring for the homes, weaving, caring for the children, cooking, and farming; while the men hunted, fished, and attended to religious matters. For tramping the snow in winter in search of wild bears, the Ainus devised a crudely made but effective snowshoe from two bent pieces of flexible wood, fashioning it in the shape of the "bear paw" type of snowshoe in use in the United States today. The Ainus were great fish eaters, and the men were adept at fashioning seagoing dugout canoes, and fish spears of several types. Large salmon weighing up to 40 pounds entered their rivers in great numbers. The Ainu men used nets, spears, and during winter months hooks and lines dangled through holes made in the ice. They attracted the fish by torchlight. The *marek*, or salmon spear, was made from a 10-foot pole with an iron hook so fixed to the shaft that when the fish is struck with it, the hook flips over, the point enters the flesh, and the more the fish struggles, the tighter the hook holds. It resembles the cant hook used by lumbermen, only it is much, much smaller.

Japan has imposed many restrictions upon the Ainus. Until the time of the Meiji restoration in 1868, they were not permitted the use of money. As a substitute they bartered with beads, sheafs of tobacco, and bearskins. It is customary for an Ainu to have but a single name, assigned at birth by the village headman. When they planned to tax the aborigines, the Japanese discovered that Ainu names could not be spelled accurately in their characters. Officials, therefore, assigned a common Nipponese family name to all inhabitants in a

(*Concluded on page 328*)

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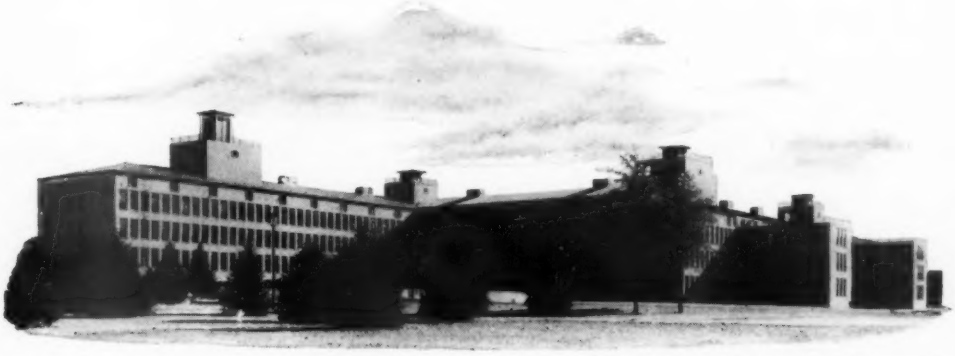

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ALONG THE ALEUTIAN ROUTE

(*Concluded from page 326*)

given village; all Ainus living in Penakori, for instance, are named Kawakami. Although their children are taught in the Japanese language, and adults must speak it in public, in the privacy of the grass homes the soft, musical, native Ainu is the language spoken by both parents and children. In an endeavor to make farmers out of nomad huntsmen and warriors, the Japanese Government assigned an acre of land to each family and forthwith taxed fishing and hunting, even for food, right out of existence.

Regarding the Ainus, the Japanese have run the gamut of emotions extending from fear through scorn to curiosity. Racial stigma was once attached to a Japanese born with wavy hair, but with the introduction of the permanent wave (before Pearl Harbor, the majority of Japanese women had waved hair) this prejudice disappeared. Recently, spurred by foreign anthropologists, the Japanese have evinced a curiosity about this strange race of men. Nipponese scientists have investigated them, and the University of Sapporo has established the largest Ainu museum in existence.

If the Ainus lack medical attention and suffer from preventable diseases, so do the Japanese settlers on Hokkaido. The Ainus have not fared well under the setup of colonial government, but neither have the Japanese colonists. The Japanese are not temperamentally suited to be either rulers of colonies or colonists. Lack of imagination and inflexibility are the greatest handicaps of the Nipponese who migrate as colonists. Thus the majority of the settlers on Hokkaido, an island with a very severe winter climate, dwell in paper and matchwood homes, unheated save for a few live coals in a brazier or *abeoi*, and dress in kimonos as they did in the milder climate of Japan proper. They do so despite the repeated advice of experts, who urge settlers to live in coldproof, heated houses, to wear woolen garments, and to increase their diet to include meat.

Physically the Ainus in no way resemble their masters. They are characterized by short, stocky bodies, round European eyes, absence of the Mongolian fold, and thick shocks of wavy, sloe-black hair. Known as the hairiest race on earth, the Ainus also have the distinction of possessing the largest skulls of any race extant. They have fine, white, even teeth. There is no accounting for their longevity considering their poverty-stricken existence, racked with preventable diseases.

For years it has been the custom to speak of the aborigines of Hokkaido as a vanishing, a doomed race. Seventy years ago the Ainu population was 12,281; today it is 16,000, an actual *increase* of 3,719. Wishful thinking probably impels the Japanese statistician who compiles the vital statistics to add to his figures a footnote stating that the Ainus are a rapidly dying race. Given $100 worth of the new drug used by the United States Office of Indian Affairs to cure trachoma, a few vitamin tablets, and an ounce of encouragement, this once virile race would flower again. By so doing it would confound all the anthropologists who, offering no material aid, have taken such pains to photograph and measure the corpse for posterity.

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THE ECONOMICS OF INNOVATION

(*Continued from page 314*)

view of the disturbances produced by rising prices, a check to inflation at this point might seem to be highly desirable. Obviously, prices cannot continue to rise forever. But unfortunately a business boom based on the expectation of price advances is likely to receive a disconcerting jolt when this expectation has to be abandoned. The prospect for profit will become less rosy. Optimism will be tempered by doubt; those who make decisions as to how much to produce will become more cautious. Some of the speculators on the security exchanges, sensing a chill in the business atmosphere, will begin to take their profits, and the prices of stocks will weaken. This development will further dampen the spirit of business enterprise.

Whether the forces of industry which had been moving forward will then begin to retreat depends to a large degree upon how far they had advanced. Just as an attacking army becomes more and more vulnerable to counterattack as its lines of supply and communication are extended, so the business system becomes more vulnerable as it moves forward on the road of prosperity. The farther it goes, the nearer do the banks approach the limit of their capacity for credit expansion; the harder are loans to get; the higher are interest rates marked up. Supply difficulties are encountered also with respect to labor and materials: The reserves of man power are not so good as the front-line troops; additional materials become costlier to produce.

Under these conditions, as the history of business cycles indicates, many important concerns will delay the execution of whatever plans they have for plant construction. They will note with some disquiet the tendency for interest rates and certain other costs to rise; they will fear the effects exerted on prices by the new consumers' goods that are coming off the production lines in increasing volume. Consequently, the demand for materials and labor in the construction industries will decline further, and from time to time the volume of savings will be in excess of expenditures for investment goods. As, periodically, some portion of the savings of the community is hoarded, the value of goods being offered for sale will be in excess of the money income being offered to purchase them. The forces making for equality will exert a downward pressure on the price level.

When prices begin to fall, the boom will collapse. Expectations of profit disappear in a falling market. The prospect of selling at tomorrow's lower prices the goods and services that were purchased at yesterday's higher costs, is enough to cause a curtailment of production. Moreover, the decline in the prices of many cost items is delayed by custom and established contracts. Thus prosperity turns into depression, and while the economic machine grinds painfully along in low gear, society is deprived of many of the commodities and services which the new technology is capable of supplying. At such times private enterprise falls into disrepute, and agitation grows for the substitution of a socialistic or authoritarian system of economic control.

(*Continued on page 332*)

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THE ECONOMICS OF INNOVATION

(*Continued from page 330*)

The foregoing observations should not be construed as a forecast of postwar events. Nothing has been said, for example, concerning the transition from war to peace. As armies are disbanded and military contracts are liquidated, we shall face the serious problem of maintaining output and employment by converting our war plants to civilian production. Unless we watch our step, this conversion period will be one of acute crisis. We are here concerned not with this crisis but with the long-run problem of maintaining income and employment after the transition from war to peace is made and after we begin to tackle the backlog of investment outlets being created in our scientific laboratories.

In thinking about the effects of technological innovation, we should bear in mind that this is not the only force which will be operating on our national economy. Changes in human attitudes and tastes, in economic, political, and legal institutions, in the rate of population growth, in the average age level, and in our relations with foreign countries may modify the effects of the scientific discoveries that are now accumulating. Moreover, the accumulation may not be so great nor its economic repercussions so far-reaching as some of us imagine. If, for example, the idle production capacity existing at the end of the war is very large or if the innovations are introduced slowly, the industrial system may be able to adapt itself to the changes without great difficulty. So many factors are unknown that one cannot predict with confidence. Yet the teachings of history and of economic analysis are sufficiently clear to put us on our guard. We may be fairly sure that the impact of a large and sudden expansion in the output of investment goods will tend to throw the economic system badly out of balance.

As to the measures that should be adopted to steady the system against the shock of this impact, there are much doubt and disagreement. One obvious method of approach is from the monetary side — to regulate through the Federal Reserve system the volume of funds furnished by the commercial banks, or to control through taxation (or other means of modifying the distribution of income) the amount of money which the community attempts to save. Another method of

(*Concluded on page 334*)

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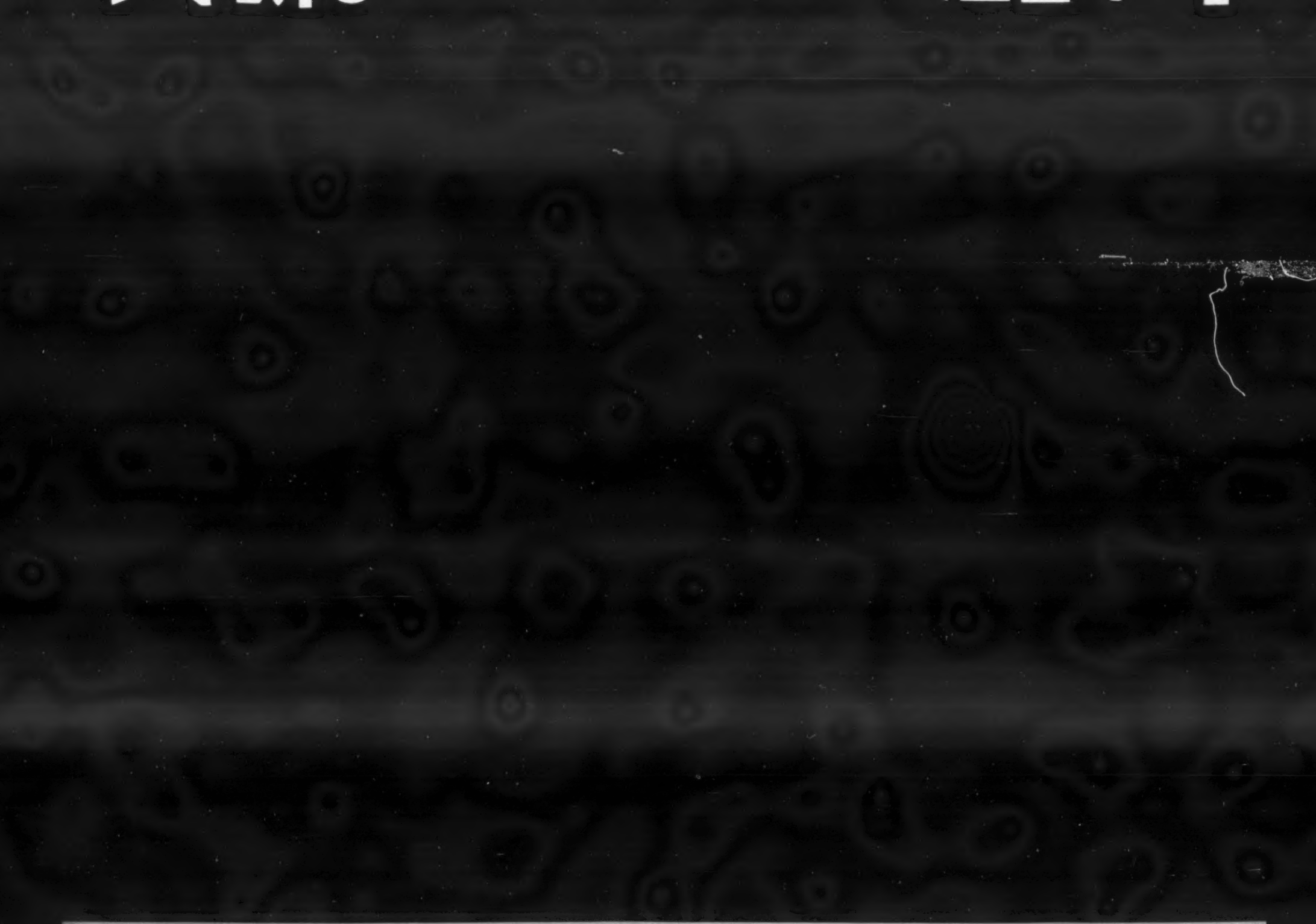

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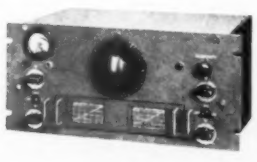
WHEELHOUSE OF A PC BOAT



Just as the wheelhouse is the nerve center of the swift little PC boats, so radio is the nerve system that links the Navy's ships together.

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Liquid

THE ECONOMICS OF INNOVATION

(*Concluded from page 332*)

approach is from the production side — to control the rate at which the new investment opportunities are exploited.

Control of the rate might be exercised either by agreement among private enterprises or by an agency of the government. Some economists visualize the necessity for the periodic introduction of public deficit expenditures to fill the gaps caused by the excess of savings over investment which appears from time to time. Others are inclined to favor a policy of nonintervention, believing a moderate depression to be a necessary period of readjustment, during which the economic system digests the innovations and renews its strength for another forward surge.

FOUR ON WAR

(*Continued from page 316*)

Father Lana need not have been so concerned about the possible misuse to which his own airship might be put, for that ship would never have left the earth even if it had been built. Nonetheless, in his mechanical ideas he was on the right track, while his prevision of things to come, with such devices as his own airship in the air, has been most horribly fulfilled to the last word. Leonardo was much more naïve than the good Father

(*Continued on page 336*)

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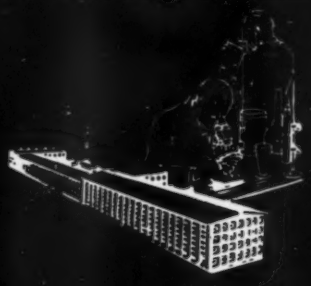

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This means two things to you as a buyer:

First, it means that capacitor problems do not stay answered. Capacitors that were "good enough" a few months ago, may be entirely outmoded by new developments. Reversely, types not thought suitable for certain applications may have been improved to a point where their use is entirely practical—as witness Sprague's pioneering of satisfactory electrolytic capacitors for airplane use.

Second, it means that Sprague is in the forefront of capacitor production for war uses. We don't pretend to have all the answers—but we do have a sufficiently large number of them that leading users find it pays to contact Sprague *first*, whatever their problem. Paper capacitors that stand up under kilovolts at 110° C.; paper units to serve as satisfactory mica capacitor substitutes; capacitors that will stand pulse voltages; paper capacitors that read "off scale" on megohm meters (more than 200,000 megohms)—such are but a few of the more recent Sprague developments. Back of each type is a broad background of engineering experience in today's critical uses that is freely available to our customers. We cordially invite you to make full use of it.

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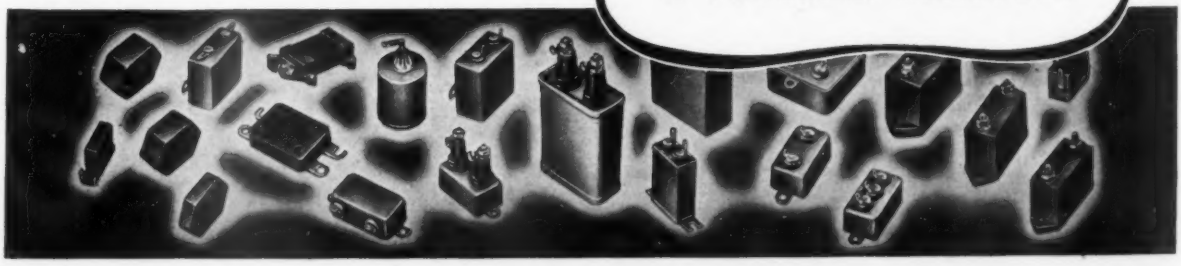

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FOUR ON WAR

(*Continued from page 334*)

Lana in his view of his attempts to construct a practicable flying machine. As he viewed the matter, the air was the one remaining element which man had not yet conquered, a birthright which would be his in the fullness of time, possibly through his, Leonardo's, agency. He did not think of man's wings as the wings of the angel of death, the wings of war, but rather as the wings of mercy, goodness, and greater happiness for all mankind.

Samuel Johnson (1709–1784) in his play *The History of Rasselas, Prince of Abyssinia*, written in January, 1759, makes the artist in the play, who had invented a flying machine, refuse to divulge his secret. "If men were all virtuous," he said, "I should with great alacrity teach them all to fly. But what would be the security of the good, if the bad could at pleasure invade them from the sky? Against an army sailing through the clouds, neither walls, nor mountains, nor seas, could afford any security. A flight of northern savages might hover in the wind, and light at once with irresistible violence upon the capital of a fruitful region that was rolling under them. Even this [the Amharic] valley, the retreat of princes, the abode of happiness, might be violated. . . . " As, alas, Mussolini's airmen were, nearly two centuries later, to prove in what they called their Ethiopian campaign, for which more humane people have another word.

If we may jump ahead more than a century to the year 1887, the year in which Jules Verne's novel *Robur the Conquerer* was published, we may listen to the words of Verne through his aeronaut Robur: ". . . the state of mind is not ready for that important revolution which will one day accomplish the conquest of the air. . . . My experiment is premature. Science should not precede the mental capacity of the times. There should be evolution, not revolution. I have come too soon and find that the time is not yet ripe for my work."

Verne believed that rapid communications rendered all ideas of nationalism nonsensical, and he concluded that people must organize their lives morally and socially for a new technical period of progress if the dangers attending the abuse of machinery and invention were to be avoided. "I bear my secret with me," said Robur. "But it will not be lost to humanity. It will be found when the world is wise enough to profit by it and prudent enough never to abuse it."

Alas, it would seem that despite the best of intentions of men, the way to hell is often facilitated by good inventions. But let us come now to Benjamin Franklin. He had been present at the balloon ascents made by the Montgolfier brothers and Charles. From Paris he wrote detailed accounts of these ascents to Sir Joseph Banks, President of the Royal Society of London. On January 16, 1784, in a letter to his friend Jan Ingenhousz, the physician of Maria Theresa, Franklin wrote:

"It appears, as you observe, to be a discovery of great Importance, and what may possibly give a new turn to human Affairs. Convincing Sovereigns of the Folly of wars may perhaps be one Effect of it; since it will be impracticable for the most potent of them to

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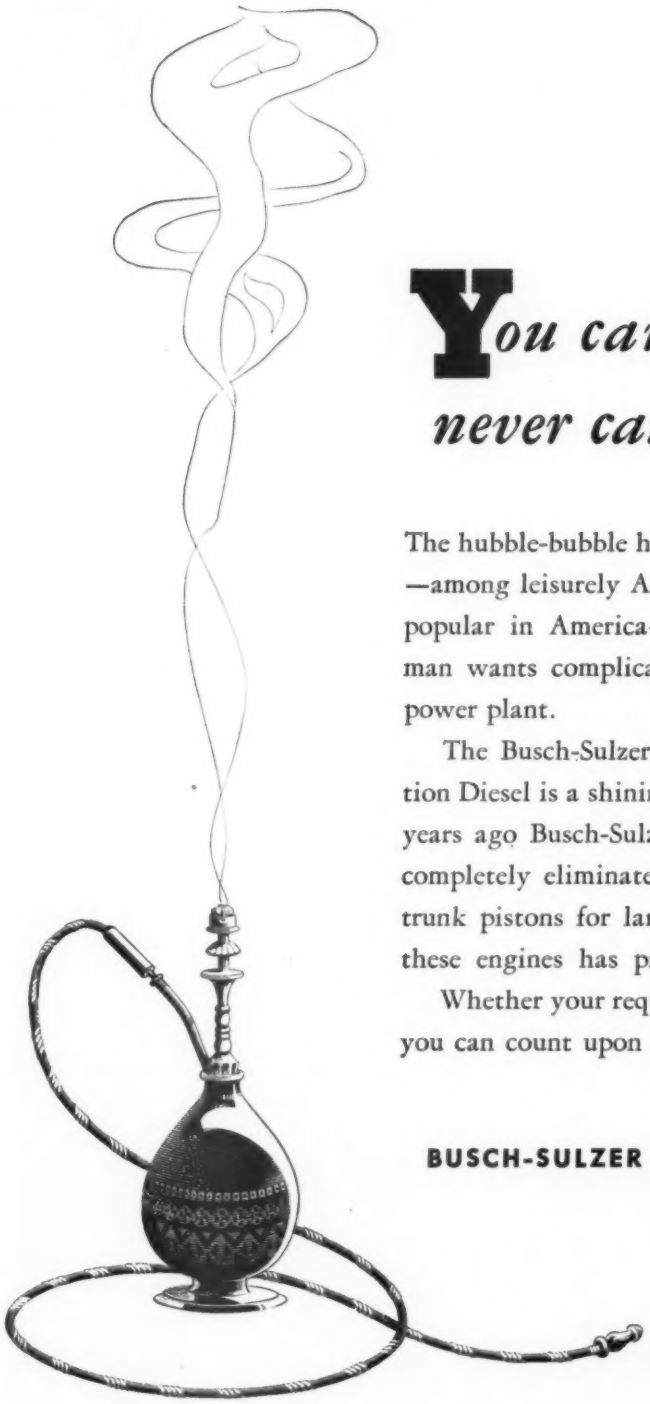

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FOUR ON WAR

(*Concluded from page 336*)

guard his Dominions. Five thousand Balloons, capable of raising two Men each, could not cost more than Five Ships of the Line; and where is the Prince who can afford so to cover his Country with Troops for its Defence, as that Ten Thousand Men descending from the Clouds might not in many places do an infinite deal of mischief, before a Force could be brought together to repel them . . . ?"[3]

From all of this may we not conclude that if most men were as reasonable, as wise, and as humane as the scientists whose views have been presented here, there would be no wars and no tragic necessity to divert our energies from creation to destruction. As it is, we are now fighting a war in which we all rightly feel that, in order to insure any creative activity for the future, it is absolutely necessary for us to destroy those who would willingly destroy us.

The job of fighting it, therefore, must be done with all the power that is within us, the sooner to bring that day nearer when we shall have successfully concluded it. We must endeavor to make sure also that after this war we shall never have to do it again, so that we may be able to increase all those benefits described more than 400 years ago by Leonardo da Vinci as "the chief gift of nature, which is liberty."

[3] *The Writings of Benjamin Franklin*, A. H. Smyth ed., Letter 1473, IX: 155.

THE TREND OF AFFAIRS

(*Continued from page 306*)

It is a misfortune of the greatest magnitude, however, that the world to date has utilized so little the two greatest principles anthropology has to offer: that all cultures should be viewed with respect and objectivity, and that whatever differences do exist among races or classes — and any major ones have yet to be conclusively demonstrated — they are not decisive. "There is no reason to believe," in the words of the late Franz Boas, "that one race is by nature so much more intelligent, endowed with greater will-power, or emotionally more stable than others that the difference would materially influence its culture." The greatest field for applied anthropology is here at home, in easing the shocks of the almost continuous changes going on in our civilization, in combating prejudice, and in buttressing with facts a humane and rational attitude toward our fellow men.

Papermaking

TO write a conventional "review" of Dard Hunter's *Papermaking; the History and Technique of an Ancient Craft* * is an impossibility. For one thing, the concentration of decades of assiduous research fills the book with such riches of fact, story, explanation, and

(*Continued on page 340*)

* New York: Alfred A. Knopf, 1943. xv + 398 + xxiii pages. $4.50.

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We cannot reveal what we are doing today in Thomas A. Edison's laboratories and plants, but the marines at Guadacanal, General Eisenhower's men in Africa, those American boys who range the skies in our fighting aircraft, and the men of our navy at battle stations the world over know that Edison-made products of true Edison-built efficiency help make their equipment the toughest and finest in the world.

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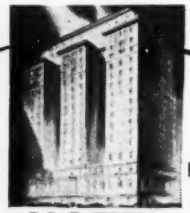

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THE TREND OF AFFAIRS

(*Continued from page 338*)

description as to forbid excerption. For another, the story is told with such craftsman's care and connoisseur's virtuosity that the more than well-satisfied reader, out of appreciation, will decline any undertaking that might dilute them. Hence the fittest approximation to a conventional review is to say that the next best thing to visiting the Dard Hunter Paper Museum at the Institute, for pleasant hours of studying under Dr. Hunter's friendly guidance the manifold treasures it contains, is to read this book.

The sweep of the book in time and space is suggested when one thinks of the multiple uses and the multiple influences — cultural, economic, scientific — of paper, "a thin, felted material formed on flat, porous moulds from macerated vegetable fibre," as Dr. Hunter defines it. From Ts'ai Lun's announcement of his invention A.D. 105 to the present, from the simplest hand fabrication in China to the most highly developed machine production in England at the rate of a quarter-mile of paper over 26 feet wide every 60 seconds, is a considerable scope. Yet the history is a unified one, and not merely because the mold of Ts'ai Lun's day embodied the essential principle upon which today's vast machine depends. The history is unified because of man's many-faceted reliance upon paper, which has extended even to religious ritual in some regions; this presentation of the history is unified not only by Dr. Hunter's surpassing knowledge of the subject but also by his balanced sympathy.

For example, here is a writer in the unique position of having produced books which were his own throughout — he wrote and illustrated them, designed the type, cut the punches and made the type, made the paper, did the printing — who might, therefore, fairly be expected to write primarily as a devotee of crafts as such. His subject, moreover, is one in which the craft motif is in many ways dominant, even in the basic aspects of the mass-production process. But the brief fourteenth chapter of this book is about the most judicious and reasoned evaluation of the comparative claims of the handmade and the machine-made thing which could be asked. The appraisal is of course in terms of paper and the uses of paper; the conclusions and philosophy in which it eventuates are universally applicable.

Within this organic frame, the book presents very many centers of individual interest. The world's first

(*Concluded on page 342*)

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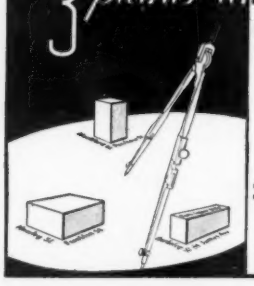

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THE TREND OF AFFAIRS

(*Concluded from page 340*)

text printing on paper, the probable source of the paper on which Thomas Jefferson made his rough draft of the Declaration of Independence, the beginning and artistic development of watermarks, the bearing of watermarks on counterfeiting, the materials and construction of the papermaker's mold, the use of mummy wrappings as raw material in the fabrication of paper in mid-Nineteenth Century America — these are a scant suggestion of the varied historical material which Dr. Hunter recounts. They indicate, however, that this is a book to which the reader will often return.

Ambigu

LEAD-BASE Babbitt-metal alloys are being successfully tested in the search for ways to save tin. One formula, containing but 1 per cent of tin and .5 per cent of copper, has shown bearing properties, fatigue strength, and corrosion resistance equal to those of tin-base babbitt. Another, in which only three-quarters of 1 per cent of tin is used, is reported as showing actual superiority to tin-base bearings in service applications. ¶ Waste paper is being used by British engineers to make expansion joints for the concrete runways of airfields. ¶ Meanwhile experimentation is under way looking to the use of paper as a substitute for jute in the sacks in which the Cuban sugar crop is packed. ¶ Wreckage of German submarines salvaged by the United States Navy along the East Coast has been found covered with an excellent crop of young marine life, including oysters and scallops. Fish farmers take note. ¶ A synthetic rubber is proving superior to natural rubber or other materials for use in the rolls of printing presses. Tests are reported to have shown the synthetic product less subject than the other substances to swelling and distortion from inks and cleaning mixtures, and superior in wearing qualities because it can be compounded to meet specific requirements. ¶ Actual cash military expenditures of the United Nations, plus the slump in national income of countries now under the Axis yoke, are computed by a writer in *Foreign Commerce Weekly* as bringing the merely monetary cost of Adolf Hitler to a sum exceeding $300,000,000,000. ¶ Tough enough to rival steel in many ways, yet weighing only a fifth as much, a plastic material has been developed for use in the forming blocks, dies, and jigs upon which the metal parts of airplanes are fabricated. Base of the new thermo-plastic is ethyl cellulose. The material melts at 200 degrees Centigrade and is poured into molds which will give the cast the shape desired. ¶ Man-made caverns would be wrought in the doleritic rock of the Hudson Palisades to provide enormous air-raid shelters, hangars, and havens for vital manufacturing plants, according to a plan suggested by John C. Evans, chief engineer of the Port of New York Authority, and advocated by George J. Atwell, New York contractor. ¶ Flame cultivation — killing weeds with jets of fire so aimed that they do not injure the crop-plants themselves — is seen as a practical method of supplanting the time-honored hoe.

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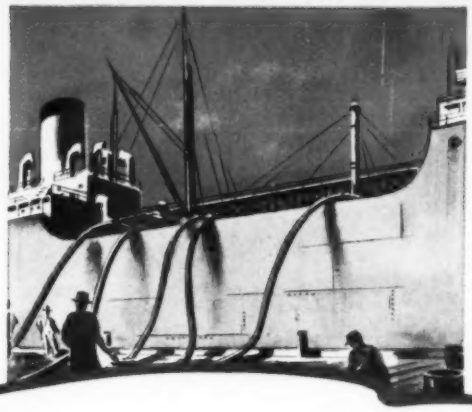

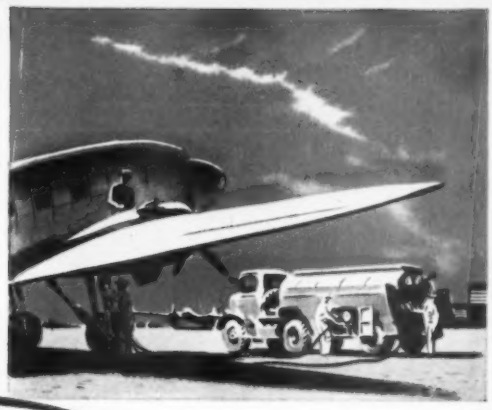

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Under today's rising and tremendous program, widely publicized, vast quantities of *all-service* synthetic rubbers will be produced in months to come to replace natural crude rubber. Differences in physical characteristics, not easily recognizable to the layman, but of profound significance to the rubber technician, present highly diversified problems in the art of compounding and using these new *all-service* synthetic rubbers.

The accumulated experience of all manufacturers in the use of special-type synthetic rubbers is proving very valuable in building up the art of substituting these new synthetic types for natural rubber. The full and free interchange of information, fostered by Washington and the Industry, is speeding the results at a pace which should confirm confidence in the ability and talent of the Industry to turn out good, usable, often better, products for War and essential civilian needs.

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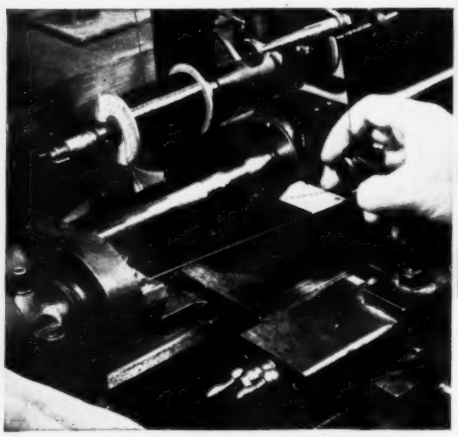
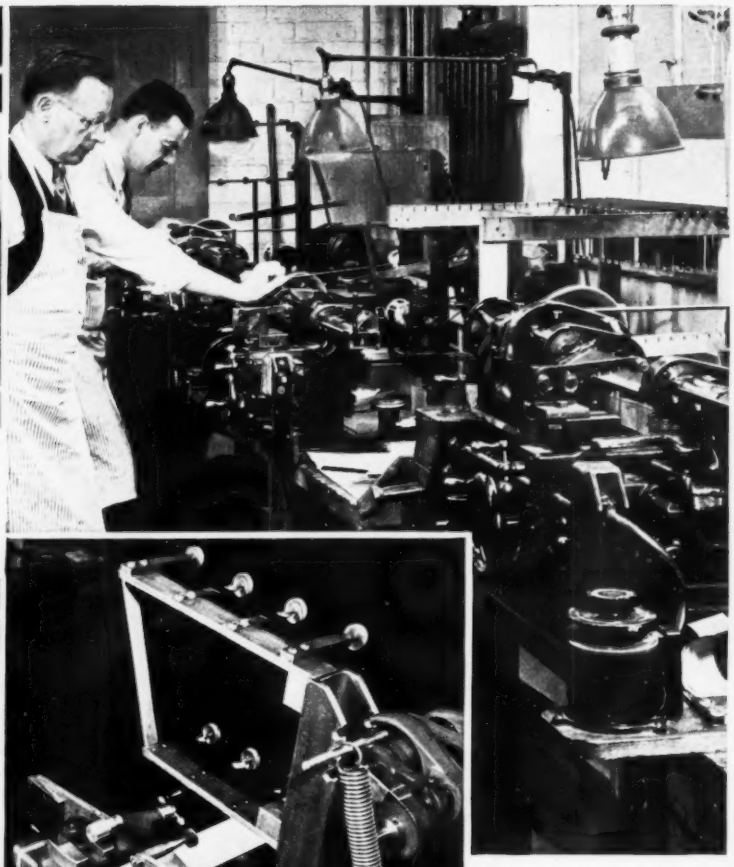
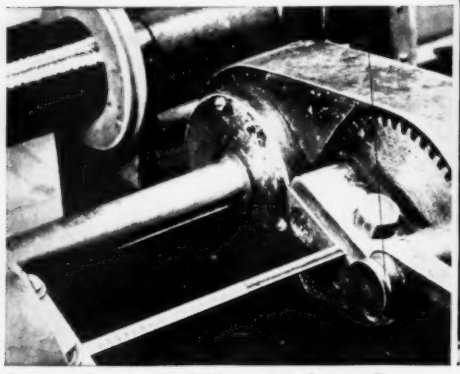


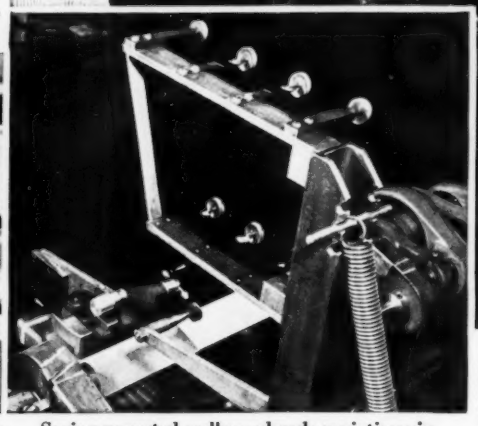
Carefully rotating the last few turns of the lathe by hand avoids collapse of the winding on the steepest slope of cards with a logarithmic taper. These logarithmic units can be used *with* an external series resistor to obtain a truly logarithmic resistance, or *without* the series resistor to give the steepest possible slope to the resistance characteristic.



Although the winding of all resistance cards for General Radio potentiometers is essentially automatic, experienced workmen adapt the winding speed to each particular unit through Variac control of the motor drive.



Putting the *second* winding on an Ayrton-Perry, or non-inductive, resistance unit. This unit is used as the output control in a standard-signal generator operating at frequencies up to 50 megacycles.



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